University of Alberta

Predicting Success, Failure and Errors in a Geriatric Self-Medication Program: A Retrospective Chart Review

By

Sheri Maddigan

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Science

in

Pharmacy Practice

Faculty of Pharmacy and Pharmaceutical Sciences

Edmonton, Alberta

Spring 2001

National Library of Canada
Acquisitions and Bibliographic Services
395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque nationale du Canada
Acquisitions et services bibliographiques
395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence

Our file Notre référence

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-60464-0

Canada

University of Alberta

Library Release Form

Name of Author: Sheri Laine Maddigan

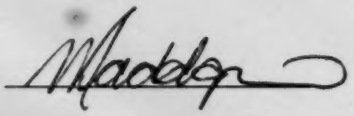
Title of Thesis: Predicting Success, Failure and Errors in a Geriatric Self-Medication Program: A Retrospective Chart Review

Degree: Master of Science

Year this Degree Granted: 2001

Permission is hereby granted to the University of Alberta Library to reproduce single copies of this thesis and to lend or sell such copies for private, scholarly or scientific research purposes only.

The author reserves all other publication and other rights in association with the copyright in the thesis, and except as herein before provided, neither the thesis nor any substantial portion thereof may be printed or otherwise reproduced in any material form whatever without the author's prior written permission.



#707 11307 99th Avenue
Edmonton, AB T5K 0H2

Date: January 3, 2001

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled Predicting Success, Failure and Errors in a Geriatric Self-Medication Program: A Retrospective Chart Review submitted by Sheri L Maddigan in partial fulfillment of the requirements for the degree of Master of Science in Pharmacy Practice.

Dr. Karen B. Farris

Dr. Jeffrey A. Johnson

Dr. Cheryl Wiens

Dr. Norah Keating

Date: November 23, 2000

Abstract

The objectives of this project were to predict (1) success in self-administration of medications and (2) probability of errors in self-administering medications. The Theory of Self-Care Deficit Served as a framework. The study included 301 older adults who had participated in a self-medication program in a rehabilitation hospital. The only statistically significant predictor of success on the self-medication program was Mini-Mental State Exam (MMSE). Multivariate logistic regression models predicting medication errors for the first and final weeks of the program were statistically significant and accounted for at least 18.6% and 43.6% of the variance, respectively. Statistically significant predictors for errors in the first week included duration of institutionalization before self-medication, medication complexity index (MCI) and interactions between (1) MCI and MMSE and (2) ability to cook and MMSE. Statistically significant predictors for errors in the final week included depression, MMSE, MCI and an interaction between MCI and MMSE.

Acknowledgments

I would like to sincerely thank everyone who assisted me in completing this thesis and helped me through the Masters of Science in Pharmacy program. My supervisor, Karen Farris, provided endless support and encouragement over the past few years. My thesis committee, Norah Keating, Cheryl Wiens, Jeffrey Johnson and Karen Farris, offered input that immensely improved the quality of this thesis. I would like to thank Cheryl Green, Northern Alberta Regional Geriatric Program Pharmacist, for helping me obtain data and the Glenrose Rehabilitation Hospital for allowing me access to the data I required. I would like to recognize the financial support that I received throughout the course of my graduate program from the province of Alberta and MacLean Hunter Health Care. I would also like to acknowledge my family, as they have always supported me in all of my endeavors. As well, I would like to thank my fellow graduate students, Carlyn and Lisa, who guided me through the adjustment phase back to student life and helped me to persevere over the past few years. Finally, I would like to thank RP, who was there for me in the end.

Table of Contents

Page

CHAPTER 1: INTRODUCTION 1

1.1.0 OBJECTIVES 6

CHAPTER 2: LITERATURE REVIEW 8

2.1.0 THE THEORY OF SELF-CARE DEFICIT 8
2.2.0 ROLE OF THE HEALTH CARE PROVIDER/PHARMACIST 15
2.3.0 THE THEORY OF SELF-CARE DEFICIT AND MEDICATION MANAGEMENT 17
2.4.0 POTENTIAL FACTORS INFLUENCING CAPACITY FOR MEDICATION MANAGEMENT IN OLDER ADULTS 20
2.5.0 APPLICATION OF THE THEORY OF SELF-CARE DEFICIT TO PAST RESEARCH 22
2.5.1 Basic Conditioning Factors and Power Components in Simulation Exercises 26
2.5.2 Summary of the Simulation Exercise Literature 34
2.5.3 Limitations to the Simulation Exercises 39
2.5.4 Validity of the Simulation Exercises 39
2.5.5 Basic Conditioning Factors and Power Components in Self-Medication Programs 41
2.5.6 Limitations of the Self-Medication Literature 46

CHAPTER 3: METHODS 49

3.1.0 OBJECTIVES 49
3.2.0 DESIGN 50
3.3.0 SETTING AND SUBJECTS 52
3.4.0 PROTECTION OF HUMAN SUBJECTS 55
3.5.0 DATA COLLECTION 55
3.5.1 Data Abstraction 55
3.5.2 Medication Complexity Index (MCI) 58
3.5.3 Mini-mental State Examination: MMSE 59
3.5.4 Activities of Daily Living 59
3.5.5 Instrumental Activities of Daily Living (IADL's) 60
3.6.0 ANALYSIS 61
3.6.1 Initial Data Reduction 61
3.6.2 Descriptive Statistics for Retrospective Cohort and Causal Comparative Analysis 62
3.7.0 STUDY OBJECTIVE ONE - RETROSPECTIVE COHORT 66
3.7.1 Study Objective One - Bivariate Analysis 67
3.7.1.1 Dependent Variable 67
3.7.1.2 Independent Variables 67
3.7.1.3 Analysis 68
3.7.2 Study Objective One: Multivariate Analysis 69
3.8.0 STUDY OBJECTIVE TWO - CAUSAL-COMPARATIVE ANALYSIS 70
3.8.1 Study Objective Two - Bivariate Analysis 70
3.8.1.1 Dependent Variables 70

3.8.1.2 Independent Variables 70
3.8.1.3 Analysis 71
3.8.2 Study Objective Two - Multivariate Analysis *71*
3.8.2.1 Dependent Variables 71
3.8.2.2 Independent Variables 73
3.8.2.3 Interaction Terms 74
3.8.2.4 Analysis 75

CHAPTER 4: RESULTS 76

4.1.0 SAMPLE CHARACTERISTICS 76
4.1.1 Demographic Information and Medication Use Variables *76*
4.1.2 Physical Assessments *82*
4.1.3 Progress on Program *86*
4.2.0 RETROSPECTIVE COHORT 88
4.2.1 Bivariate Analysis *89*
4.2.2 Multivariate Analysis *91*
4.3.0 STUDY OBJECTIVE TWO - CAUSAL COMPARATIVE ANALYSIS 91
4.3.1 Bivariate Analysis: Week One Error Rate *91*
Education *93*
4.3.2 Bivariate Analysis: Final Week Error Rate *94*
Education *95*
4.3.3 Bivariate Analysis: Overall Error Rate *96*
Education *97*
4.3.4 Multivariate Analysis: Initial Week of Self-Medication *98*
4.3.5 Multivariate Analysis: Final Week of Self-Medication *103*
4.3.6 Multivariate Analysis: Entire Duration of Self-Medication *108*
4.3.7 Multivariate Analysis: Summary *112*

CHAPTER 5: DISCUSSION 114

5.1.0 MAJOR FINDINGS 114
5.2.0 RESEARCH IMPLICATIONS 123
5.3.0 PRACTICE IMPLICATIONS 129
5.4.0 CONCLUSIONS 137

BIBLIOGRAPHY 140

APPENDIX A: ETHICS APPROVAL 147

APPENDIX B: DATA ABSTRACTION FORM AND PATIENT ASSESSMENTS 151

List of Tables

Page

Table 2.0: Study Design - Simulation Exercises 27

Table 2.1: Simulation Exercise Findings 31

Table 2.2: Design of Self-Medication Studies 42

Table 2.3: Measures and Findings from Self-Medication Studies 43

Table 3.0: Number of Subjects Required According to Varying Effect Sizes 54

Table 3.1: Abstracted Data and Location of Chart from which Data were Abstracted 56

Table 3.2: Summary of Descriptive Statistics 63

Table 3.3: Coding of Independent Variables in the Logistic Regression Analyses 74

Table 4.0: Demographic Characteristics of Study Sample 77

Table 4.1: Descriptive Statistics for Demographic Information and Medication Use Variables 78

Table 4.2: Psychomotor Function 83

Table 4.3: Comparison of Study Population to the Canadian Population 85

Table 4.4: Descriptive Statistics Summarizing Progress on Self-Medication Program ... 87

Table 4.5: Reason for Program Termination Earlier than Discharge (N=26) 88

Table 4.6: Relationship Between Basic Conditioning Factors, Therapeutic Self-Care Demand and Program Success for Continuous Variables 89

Table 4.7: Relationship Between Basic Conditioning Factors, Power Components and Program Success for Categorical Variables 90

Table 4.8: Relationship Between Basic Conditioning Factors, Power Components and Week One Error Rate 93

Table 4.9: Relationship Between Basic Conditioning Factors, Power Components and Final Week Error Rate 95

Table 4.10: Relationship Between Basic Conditioning Factors, Power Components and Overall Error Rate 97

Table 4.11: Model Coefficients for Week One Logistic Regression 100

Table 4.12: Model Coefficients for Final Week Logistic Regression 106

Table 4.13: Model Coefficients for Overall Logistic Regression 110

List of Figures

Page

Figure 2.0: Theory of Self-Care Deficit 9

Figure 2.1: Components of the Self-Care Agency Construct and Self-Care Operations .. 11

Figure 3.0: General Study Design 51

Figure 4.0: Percent of Sample in each MCI Grouping 79

Figure 4.1: Reason for Admission to Glenrose Rehabilitation Hospital 80

Figure 4.2: Number of Chronic Medical Conditions 81

Figure 4.3: Percentage of Study Sample Affected by each Category of Medical Condition 82

Figure 4.4: Frequency Distribution of Scores on MMSE 84

Figure 4.5: Two Dimensional Representation of Interaction Between MMSE and MCI for Week One Logistic Regression 101

Figure 4.6: Two Dimensional Representation of Interaction Between MMSE and Cooking for Week One Logistic Regression 103

Figure 4.7: Two Dimensional Representation of Interaction Between MMSE and MCI for Final Week Logistic Regression 108

Figure 4.8: Two Dimensional Representation of Interaction Between MMSE and Money Management for Overall Logistic Regression Model 111

Chapter 1: Introduction

Capacity for medication management is determined by the ability to perform a number of psychomotor and cognitive activities required to administer medications as prescribed or directed. Medication management in older adults is of concern, as they consume the most medications and have a number of characteristics that place them at risk for reduced ability. There are health, social and economic consequences of inability to manage medication regimens.

Medication use across all age groups continues to rise, a trend attributed to society's heightened awareness of morbidity from illnesses, decreased thresholds of tolerance for illness and beliefs that more illnesses are curable or treatable by new medications (Vuckovic & Nichter, 1997). While all segments of society are consuming more medications, the prevalence of co-morbid medical conditions in the Canadian older adult population contributes to their disproportionately high consumption of prescription medication. Individuals over the age 65 years represent approximately 12% of the Canadian population, yet they consume 20% to 40% of all prescriptions (Grymonpre, 1998). The 1994/95 National Population Health Survey demonstrated that 10% of Canadians aged 65 to 74 and 13% of Canadians aged 75 and older took five or more medications in the two days prior to the interview (Millar, 1998). Medication regimens in frail older adults tend to be complex and demand high levels of ability to manage effectively.

Complexity of a medication regimen alone does not necessarily lead to difficulties in medication management, as certain characteristics of individuals contribute to ability. Visual acuity, cognitive ability, fine motor skills, memory function and the abilities to

understand instructions and remember text contribute to the capacity to manage medication regimens effectively and without error (Botelho & Dudrak, 1992; Coons et al., 1995; Larrat, Taubmen, & Willey, 1990; Murray, Darnell, Weinberger, & Martz, 1986; Ryan, 1999). Age-related changes in physical functional capacity, sensory acuity and cognition are prevalent in older populations (Allen & Mor, 1997; Campbell, Crews, Moriarty, Zack, & Blackman, 1999; Canadian Study of Health and Aging Working Group, 1994). Such age-related changes, together with the complexity of older adults' medication regimens, can potentially make medication management problematic for some older adults. As an example, Hallworth and Goldberg (1984) found that 74% of elderly patients recognize their medications by colour or shape as opposed to drug name; however, Ruscin and Selma (1996) found that 34% of patients were unable to distinguish tablet colour, and when considering only those with cognitive impairment, this percentage increased to 56%.

When discordance arises between the level of skill that is required for effective medication management and the level of skill possessed by community dwelling older adults, serious consequences can arise. These consequences include medication errors, nonadherence and their sequalea such as medication-related problems, deterioration of health status and hospitalization (Conn, Taylor & Wienke, 1995; Morrow, Von Leirer, & Sheikh, 1988). Gyrmonpre et al. (1988) found that 2.3% of all hospital admissions were the result of medication errors and that 10% of hospital admissions involving prescription drug use were attributable to medication errors. As well, inability to manage medications effectively has been linked to unintentional nonadherence and its ramifications, which

create substantial health, economic and social costs (Murray et al., 1986; Nikolaus et al., 1996).

Typically, 30-60% of patients intentionally or unintentionally do not adhere to medication regimens (Claydon & Efron, 1994). Failure to adhere to medication regimens has the potential to create untoward effects. Coambs et al. (1995) estimated the economic costs of nonadherence in Canada to be seven to nine billion dollars annually. The costs associated with nonadherence include emergency room visits, hospitalizations, additional diagnostic tests, and additional prescriptions, all costs that could be avoided if the original medication was taken as prescribed (NCPIE, 1995). Murray et al. (1986) found that approximately 53% of episodes of nonadherence placed patients at risk for morbidity and Sullivan, Kreling, and Hazlet (1990) reported that 5.3% of hospital admissions could be attributed to nonadherence. Other costs associated with nonadherence include lost productivity, absenteeism and additional health care expenditures attributable to excessive recovery times or symptoms of chronic illness (NCPIE, 1995).

In 1997, 14.5% of health care expenditures in Canada was on pharmaceuticals. This percentage is expected to reach 15.2% in 1999 (Canadian Institute of Health Information, 1999). In order to justify medication use as a cost-effective tool in the management of chronic and acute medical conditions, positive outcomes must be achieved. Compliance is one of the many factors essential to achieving positive outcomes from medications, and complying with a medication regimen requires effective medication management skills. The cost of pharmaceuticals alone is one reason why older adults' ability to manage medication regimens should be of concern.

Older adults are often the focus of interventions to improve adherence, as certain characteristics associated with unintentional nonadherence are more prevalent in this population. Examples of these characteristics include high degrees of medication regimen complexity, difficulty in understanding medication regimens and medical advice, decreased ability to open vials and decreased ability to read prescription labels due to reduced visual acuity (Coons et al., 1995; Larrat, Taubmen, & Willey, 1990; Murray, Darnell, Weinberger, & Martz, 1986). As well, older adults may be at increased risk for nonadherence due to a lack of social support that may accompany aging (Doherty, Schrott, Metcalfe, & Iasiello-Vailas, 1983; Greene, Weinberger, Jerin, & Mamlin, 1982).

Perhaps one of the most important social implications of inability to manage medication regimens effectively arises from its detrimental impact on independence. Approximately 23% of nursing home admissions result from inability to take medications in accordance with instructions (Col, Fanale & Kronhom, 1990). As well, increasing need for assistance with medication management has been shown to increase the likelihood of being admitted to homecare (Liu & Lazaruk, 1998). These two findings demonstrate the importance of effective medication management to preserving independence in older adults. Furthermore, maintaining independence and control over self-care activities (such as medication management) is important, as independence and control have been shown to contribute to self-worth, self-regard, self-concept and well-being in older adults (Jirovec & Maxwell, 1993; Smits & Kee, 1992). Thus, ensuring appropriate medication management is not only important in an economic context, but also in a social context.

Increased support from health care providers, family members and friends and intervention or assistance when needed could enhance older adults' capacity to manage

medication regimens effectively, thus limiting negative social and economic consequences of deficits in medication management capacity. More importantly, older adults with insufficient skills to manage their medication regimens effectively should be identified before negative consequences arise. The benefits of screening for potentially ineffective medication management do not only affect individual older adults, but also effect society as some of the unnecessary health care costs associated with unintentional noncompliance, medication errors, emergency room visits, hospitalization and nursing home admissions could be reduced.

The most substantial impact could be made if health care providers proactively offered the appropriate level of assistance, but in order to intervene accordingly, community and institutional health care providers should use criteria that have been shown to predict capacity for medication management. This would allow efficient identification of older adults who would be likely to have difficulties in medication management and prevent providers from intervening when unnecessary. An example of how such criteria could be applied in community pharmacy would be in screening for older adults who may benefit from specialized packaging designed to enhance adherence and reduce medication errors. As well, community pharmacists could use the criteria to identify older adults who may benefit from their medications being dispensed in easily accessible packaging.

These screening criteria are not specific to pharmacy, as they could also be used by geriatric and home care nurses to identify older adults who may require assistance with medication administration. Home care nurses and pharmacists could then work with older adults to develop a system for administration that would maintain their

independence. In addition, acute care hospital staff could use such criteria to identify older adults likely to have difficulties with medication management after discharge into the community. They could then work with community pharmacies and home care to enhance the older adult's medication management capacity.

Although past research has attempted to identify factors that could be used to screen individuals for potential problems with medication management, no definitive or comprehensive screening criteria have been established, particularly criteria that could be routinely used by community providers. While cognitive function appears to be important, the role of physical functional ability is less clear (Edelberg et al., 1999; Fitten et al., year; Fulmer & Gurland, 1997; Gurland et al., 1994; Meyer & Schuna, 1989; Selma & Ruscin). Moreover, how physical functional ability and cognitive function interact to predict medication management capacity has not been researched. Furthermore, it is not clear if certain domains on assessments of physical functional ability are better predictors of medication management capacity. As many older adults consume multiple medications, it would also be important to assess how cognitive and physical function ability interact with the complexity of medication regimens to predict medication management capacity. Since much of the past research into medication management capacity has focused on univariate analysis or used predictors that may not be widely accessible to community practitioners, there remains a need for further research.

1.1.0 Objectives

The overall objective of this research project was to use the Theory of Self-Care Deficit to predict older adult's ability to manage medications. Specifically, (1) success or

failure in medication management and (2) rates of medication errors were used as measures of medication management capacity. As well, the interactions between (1) movement abilities and cognitive limitations and (2) complexity of medication regimens and cognitive limitations were explored.

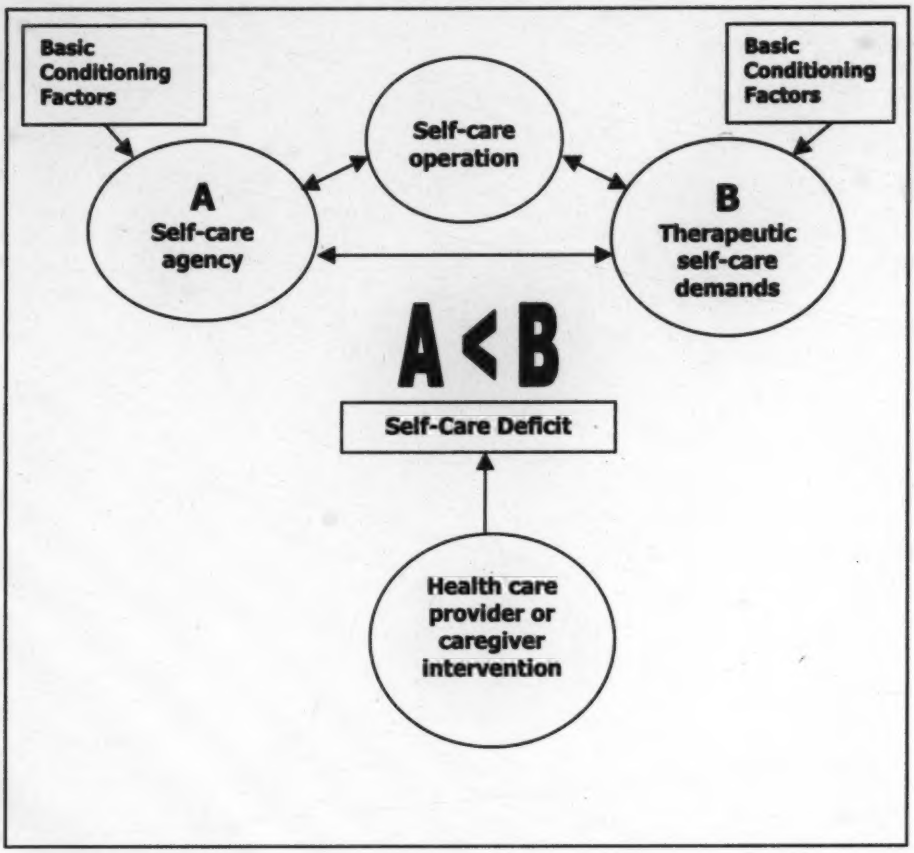
Chapter 2: Literature Review

Effectively managing a complex medication regimen requires a combination of skills and abilities. Across the population of older adults, the level of such skills and abilities vary. Some older adults may be unable to administer their medication regimens as prescribed simply because they lack the skills required to do so. When healthcare professionals fail to recognize individuals who lack sufficient medication management skills, negative consequences may arise; thus, it is important to identify those individuals who are at risk before adverse outcomes occur. This chapter will first review the Theory of Self-Care Deficit and use this theory to assess the abilities that affect the older adults' capacity for medication management. The past literature that has examined the skills and abilities that affect older adults' medication management capacity will be summarized and critiqued. Next, the impact which poor medication management capacity can have on older adults will be presented. Following this, the role that healthcare providers could assume to assist older adults in medication management will be discussed, again using the Theory of Self-Care Deficit as a framework.

2.1.0 The Theory of Self-Care Deficit

The Theory of Self-Care Deficit can be used to guide health care providers' interventions into medication management in older adults and is outlined in Figure 2.0.

Figure 2.0: Theory of Self-Care Deficit (Orem, 1991)



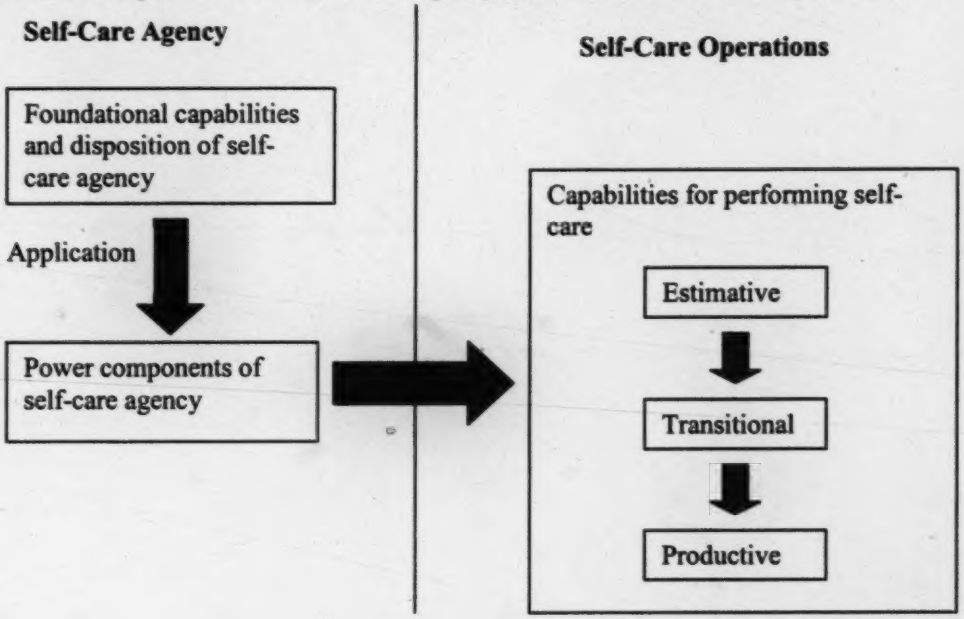
The Theory of Self-Care Deficit explains the interaction between the self-care capabilities of individuals and the level of self-care they require (McDermott, 1993). Self-care is a basic human regulatory function, dependent upon deliberate actions of individuals; thus, individuals may chose or chose not to engage in self-care (Orem, 1995). Self-care has been defined as "the practice of activities that individuals personally initiate and perform on their own behalf in maintaining health, life and well-being" (Orem, 1991), for example, taking medications. These activities are termed self-care requisites

and fall into three categories: universal self-care, developmental self-care and health-deviation self-care. Universal self-care requisites are universally required goals that must be attained in order to sustain life (Orem, 1991). Examples include adequate air, food and water intake. Performing basic activities of daily living would also be considered universal self-care requisites. Developmental self-care requisites include factors that are required to promote normal human growth and development (Orem, 1991). Examples include the provision and maintenance of conditions that prevent sensory deprivation or overload, promote cognitive development and prevent states of fear, anger or anxiety (Orem, 1991). Health-deviation self-care requisites arise from abnormal states of health such as illness or injury, disabilities associated with specific pathologies or arise from the medical care one receives to diagnose or treat an illness (Orem, 1991). When health status is compromised, individuals must perform additional self-care activities in order to improve their health status (Orem, 1995). When individuals follow prescribed diagnostic, therapeutic and rehabilitative measures, they are fulfilling health-deviation self-care requisites (Orem, 1991). Thus, medication management is a health-deviation self-care requisite.

Figure 2.0 illustrates that the ability to fulfill self-care requisites is determined by the two constructs: self-care agency and therapeutic self-care demand. Self-care agency is the ability to initiate and perform self-care activities and is an acquired human characteristic. Therapeutic self-care demand is the set of self-care activities that must be performed to meet an individual's self-care needs at a certain point in time. When individuals engage in self-care, they are said to be performing self-care activities or self-care operations. Thus, in the model, the actual behaviour would be the self-care activity,

in this case, medication self-administration and self-care agency would be the skills and abilities that individuals possess that would be used to manage medication regimens effectively. The therapeutic self-care demand would be determined, in part, by the complexity of an individual's medication regimen. The structure of the self-care agency construct is complex and is outlined in Figure 2.1.

Figure 2.1: Components of the Self-Care Agency Construct and Self-Care Operations



Self-care agency is a construct that reflects individuals' capabilities to engage in the operations or activities essential for performing self-care; thus, self-care agency is actually a learned human characteristic (Orem, 1995). Alternately stated, self-care agency encompasses individuals' skills, capabilities, limitations and motivations to perform self-care, which are referred to as (1) foundational capabilities and dispositions and (2) power components.

Foundational capabilities and dispositions are common human foundations required for engagement in any type of deliberate action, not only self-care (Gast et al., 1989; Orem, 1995). Foundational capabilities can be categorized as emotional, mental, physical, motivational and orientative and include items such as individual's ability to learn, reason and make decisions, knowledge, prior abilities, lifelong learning experiences, values and resource availability (Orem, 1995). Thus, foundational capabilities include basic sensory and cognitive functioning. Examples of dispositions that influence self-care agency include self-understanding, self-awareness, self-concept, self-image, self-concern, acceptance of bodily functions, willingness to meet needs or self and future directedness (Orem, 1995).

When individuals specifically use the foundational capabilities and dispositions to perform self-care activities (operations), the foundational capabilities are then termed the 'power components' of the self-care agency construct. In the Theory of Self-Care Deficit, there are 10 power components. The power components are enabling capabilities specifically for self-care, whereas the foundational capabilities relate to any deliberate action, not just self-care. Examples of power components in self-care agency include motivation to perform self-care, the ability to make decisions about self-care, ability to reason within a self-care framework, ability to acquire knowledge about self-care from authoritative sources, retain and use this knowledge to perform self-care, cognitive, perceptual, manipulative skills needed to perform self-care activities, having the energy to perform self-care activities and motivation to achieve the goals of self-care (Orem, 1995). The 10 power components have been demonstrated to yield five separate factors: (1) cognitive abilities, reasoning, knowledge and judgement, (2) movement abilities, (3)

motivation, (4) skills and (5) cognitive limitations (Carter, 1998). The degree to which power components are present dictates the capability of an individual to perform the operations of self-care.

To exercise self-care agency and subsequently engage in a self-care activity (operation), individuals progress through estimative, transitional and productive phases. It is at this point in the model that the actual behaviour is initiated. The initial phase of a self-care operation involves estimative operations, as the individual first seeks the knowledge required to decide what self-care activity should be performed. Transitional operations follow, as the individual decides what activities must be performed to achieve self-care and the consequences of engaging or not engaging in the activities. The final phase of a self-care operation is comprised of productive operations including preparations for self-care, carrying out self-care activities and monitoring for desired and untoward effects of the self-care activities. As part of the productive operation, the individual decides to cease or continue the self-care activity.

As previously stated, in medication management, the therapeutic self-care demand is created, in part, by the complexity of a medication regimen. A self-care deficit exists when therapeutic self-care demands exceed self-care agency (Orem, 1995). Internal and external factors influence an individual's self-care agency, self-care requisites, therapeutic self-care demands and thus the magnitude of the self-care deficit. Some internal and external factors remain constant throughout life, while others are more dynamic. In the Theory of Self-Care Deficit, the internal and external factors are termed basic conditioning factors and include age, gender, developmental state, health state, sociocultural orientation, health care system factors, family system factors, pattern of

living, environmental factors and resource availability and adequacy (Orem, 1991). As a point of clarification, since basic conditioning factors influence self-care agency, basic conditioning factors also influence foundational capabilities and dispositions and power components, since they comprise the self-care agency construct.

Health care providers must be cognizant of the basic conditioning factors as they alter the magnitude of the self-care deficit. As basic conditioning factors change, therapeutic self-care demands, self-care deficits and self-care agency may change, dictating the need for health care providers to adjust their roles accordingly.

The role that a caregiver or health care provider assumes when an individual experiences a self-care deficit is dependent upon the magnitude of the self-care deficit. Generally, roles can be categorized as wholly compensatory, partially compensatory or educative/supportive (Eben, Gashti, Hayes, Marriner-Tomat, Nation & Nordmeyer, 1994). In a wholly compensatory system, the caregiver or health care provider is responsible for self-care activities because the individual is not capable of performing any activities required for self-care. In a partially compensatory system, the individual receiving care can meet some of their therapeutic self-care demand, so caregiver or health care provider assists the individual with self-care, rather than assuming complete control over the individual's care. In the partially compensatory system, the magnitude of the self-care deficit is not as great in the wholly compensatory system. In an educative/supportive system, the individual is capable of meeting his or her therapeutic self-care demand, thus the role of a caregiver or health care provider is minimal as there is no self-care deficit (Eben et al., 1994).

2.2.0 Role of the Health Care Provider/Pharmacist

It is imperative that older adults who could potentially have difficulties in medication management are identified before problems arise. When a self-care deficit exists for medication management, community pharmacists are positioned to assume partially compensatory roles. For individuals without self-care deficits, pharmacists can assume educative/supportive roles. Generally, pharmacists' interventions may include verbal counseling, written information, compliance packaging, memory aids and follow-up contact. Each activity could occur in any of the three systems (educative/supportive, partially compensatory or fully compensatory), alone or in various combinations. The effectiveness of pharmacists' interventions has been assessed by measuring medication errors, adherence and medication knowledge.

The effectiveness of pharmacists' interventions to assist older adults with medication management varies. Singhal et. al. (1999) identified 20 studies (not all in older adults) that demonstrated improved adherence as a result of pharmacists' interventions; thus, there is evidence to support pharmacists' interventions into medication management. Past research has found that interventions using more than one technique are usually more effective than single techniques, though some studies report positive findings from using one technique alone. For example, three of four studies in older adults found that adherence and knowledge of medications regimens could be improved through verbal counseling alone (Edwards & Pathy, 1984; Hammarlund et. al., 1985; Johnston et al., 1986). Hammarlund et. al.'s study sample was purposively selected to represent older adults with medication management issues such as over or under usage, difficulties reading labels, poor medication storage and sharing of prescription

medications. The intervention included intensive one-to-one counseling and resulted in a 39% decrease in the overall number of medication management problems at a one-year follow-up.

Other studies have compared the effectiveness of multi-faceted interventions to single intervention techniques in older adults. Two studies that compared counseling alone to counseling and compliance packaging or a memory device found that the combination of the two was more effective than counseling alone in improving adherence to medication regimens (Ascione & Shimp, 1984; Martin & Mead, 1982). Ascione and Shimp found that medication knowledge was enhanced most significantly by oral instructions alone or in combination with memory devices. Hawe and Higgins (1990) demonstrated that pharmacist counseling, combined with written medication cards, was more effective than a general health education intervention. It should be noted, however, that one study found no difference between a group of older adults who received 15 minutes of counseling and a group of older adults who received the same counseling and memory devices (MacDonald et al., 1977). In this study the subjects found the memory devices difficult and time consuming to use and this resulted in frustration for the subjects. Thus, when planning interventions it is important to consider whether older adults have the capacity and desire operate the memory device, or it may be of little added benefit.

Verbal and written counseling are primarily educational approaches; thus, may be considered mainly educative/supportive activities and would be most applicable when the self-care deficit was minimal. Alternately, verbal and written counseling could be used in conjunction with other interventions such as memory devices and compliance aids in a

partially compensatory system. Memory devices and compliance aids have the potential to reduce the therapeutic self-care demand of a medication regimen and increase older adults' self-care agency. There is evidence to support the assertion that pharmacists' interventions can provide the support necessary to enable older adults to continue self-administering their medications, preserving autonomy while reducing the risk of self-care deficits, medication errors and nonadherence.

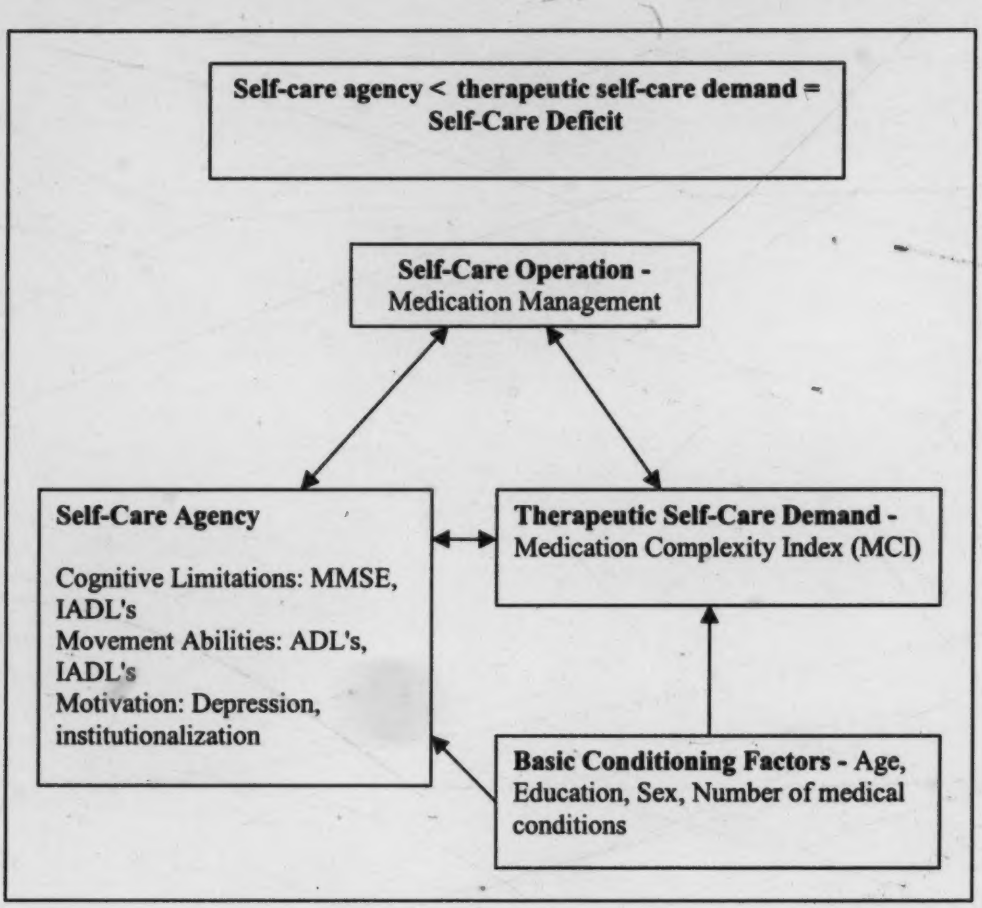
In order to intervene and assume a role in correcting a self-care deficit, community pharmacists must first be able to identify patients with self-care deficits. In order to intervene according to the magnitude of the self-care deficit, healthcare providers should use criteria that have been shown to predict capacity for medication management. This would allow efficient identification of older adults who would be likely to have difficulties in medication management and prevent the negative consequences of poor medication management.

2.3.0 The Theory of Self-Care Deficit and Medication Management

Since medication management requires deliberate action and is a self-care operation, the Theory of Self-Care Deficit is a suitable framework for exploring what characteristics affect older adults' ability to self-administer medications. When applying the Theory of Self-Care Deficit to medication management, therapeutic self-care demand would be determined in part by the complexity of the medication regimen. Characteristics such as visual impairment, hearing impairment, literacy and manual dexterity would dictate the degree to which the power components are present; thus, they are foundational capabilities and dispositions. As previously stated, the power components yield five factors: (1) cognitive abilities, reasoning, knowledge and judgement, (2) movement

abilities, (3) motivation, (4) skills and (5) cognitive limitations (Carter, 1998). Thus, power components for medication management could be determined through measures such as the Mini-Mental Status Examination (cognitive limitations), assessment of functional capacity using measures of activities of daily living (movement abilities), assessment of ability to perform instrumental activities of daily living (movement abilities and cognitive limitations) and surrogate measures of motivation such as depression or prolonged institutionalization, as shown in Figure 2.2. Finally, age, sex, number of medications, education (resource availability) and number of medical conditions (health state) would be considered basic conditioning factors, as each would impact older adults' self-care agency, as well as therapeutic self-care demand.

Figure 2.2: Theory of Self-Care Deficit and Medication Management


Self-care agency < therapeutic self-care demand = Self-Care Deficit
Self-Care Operation - Medication Management
Self-Care Agency
Cognitive Limitations: MMSE, IADL's
Movement Abilities: ADL's, IADL's
Motivation: Depression, institutionalization
Therapeutic Self-Care Demand - Medication Complexity Index (MCI)
Basic Conditioning Factors - Age, Education, Sex, Number of medical conditions

2.4.0 Potential Factors Influencing Capacity for Medication Management in Older Adults

To some extent, medication regimen complexity dictates therapeutic self-care demand in medication management. The National Population Health Survey demonstrated the complexity of older adults' medication regimens as 10% of Canadians aged 65 to 74 and 13% of Canadians aged 75 and older took five or more medications in the two days prior to the interview (Millar, 1998). In Alberta specifically, high utilization rates have also been reported. In two rural communities, Torrible and Hogan (1997) found that on average older adults took 5.6 prescribed medications and 3.5 over the counter medications on a daily basis. In order to be managed effectively, these complex medication regimens require higher levels of skill and ability. If the therapeutic self-care demand exceeds older adults' self-care agency, a self-care deficit can arise.

Visual acuity, cognitive ability, fine motor skills, memory function, and the ability to understand instructions and remember text may make important contributions to self-care agency in medication management. In later stages of life, these skills and abilities begin to decline and may diminish to the point that older adults' capacity to manage their medication regimens effectively is compromised. In fact, approximately 8% of Canada's population over the age of 65 and 34.5% over the age of 85 have some degree of cognitive impairment (Canadian Study of Health and Aging Working Group, 1994). As well, approximately 18% of adults over the age of 70 have some degree of visual impairment, while approximately 33.2% have hearing impairment (Campbell et. al., 1999). Sensory and cognitive impairment contribute to functional decline in older adults. It has been demonstrated that those aged 65 and older required or received assistance in performing an average of 2.1 activities of daily living (i.e., bathing,

dressing, eating, transferring, toileting and moving around indoors) and 2.8 instrumental activities of daily living (i.e., cooking, housekeeping, shopping and transportation (Allen & Mor, 1997). Havens and Finlayson (1999) found that 3.5% of adults aged 65 to 74 required assistance with tasks relating to personal care, with the percentage increasing to 7.2% of those aged 75 to 84 and 17.8% of those aged over 85. Thus, it is apparent that functional, cognitive and sensory decline is prevalent in older adults. Self-care agency is impacted by cognitive limitations and movement abilities; thus, functional, cognitive and sensory decline may limit the ability to effectively manage medication regimens and could potentially create self-care deficits.

In addition to physical abilities and cognitive functioning, knowledge of medication regimens influences older adults' self-care agency in medication management. Age-related changes in sensory function and cognition, combined with poor communication from health care professionals, may result in older adults having insufficient knowledge of their medications. For example, Stewart and Pearson (1999) found that following discharge from an acute care facility, 75% of patients possessed inadequate knowledge of their medication regimens. As well, Nikolaus et al. (1996) found that only 45% of older adults knew the names and indications of all of their medications three months after discharge. Moreover, 16% did not know the name and indications of any of their medications three months after discharge.

In addition to psychomotor abilities, cognitive capacity and knowledge, effective management of a complex medication regimen requires motivation. Apathy may place individuals at risk for self-care deficits in medication management through the motivation factor of the power components of self-care agency. Depression and prolonged

institutionalization are associated with apathy in older adults (Resnick, Zimmerman, Magaziner, & Aldelman, 1998; Barder, Slimmer & Lesage, 1994). However, these associations become complicated by the interrelationships amongst depression, institutionalization, cognition, psychomotor abilities and apathy. Cognitive impairment, itself, predicts functional ability (psychomotor ability) at both admission to and discharge from rehabilitation facilities (Resnick & Daly, 1998). Major depression is a cause of both apathy and cognitive impairment (Marin, Firinciogullari, & Bieddrzycki, 1993; Forsell, Jorm, Winbald, 1994) and, thus, may be an important risk factor for medication mismanagement. As prolonged institutionalization has been associated with increased dependency in performing activities of daily living, learned helplessness and depressed mood (Barder, Slimmer, & Lesage, 1994), it may also be a risk factor for self-care deficits in medication management. Thus, older adults who have been institutionalized may lack the motivation and capacity to manage a complex medication regimen due to the intricate relationships between depression, cognitive impairment and apathy, all of which may impact self-care agency.

2.5.0 Application of the Theory of Self-Care Deficit to Past Research

Past research has attempted to identify basic conditioning factors and power components that predict capacity for medication management. Two distinct methodologies have been used, each with unique strengths and weaknesses. One approach has involved simulated exercises in which the participants demonstrated their capacity to perform a number of activities commonly associated with medication self-administration. A shortcoming of this approach is that the activities which individuals were asked to perform did not always reflect the activities that they would have to

perform in order to administer their own medications. For example, individuals may have been asked to remove tablets from a vial or split tablets in half. If their medications were administered from a Dosett® (rather than vials) or their medication regimen did not involve splitting tablets, the inability to perform such tasks would not give a valid indication of those individuals' inability to administer their own medications. If such assessments were carried out using the individual's own medications and the steps that would have to be taken to manage their medication regimens were assessed, the results would give a more valid indication of ability. As well, these exercises assess whether an individual is capable of performing tasks required to manage medication regimens, without determining whether individuals actually adhere to their medication regimens.

The alternate methodology involved assessing which factors were associated with success in a self-medication program. Self-medication programs in hospital settings allocate the responsibility of medication administration to patients within a controlled and closely monitored setting. Participants in self-medication programs are generally cognitively intact, able to read English, have minimal psychomotor impairments and will manage their medications after discharge from the hospital (Barry, 1993). Thus, the degree to which the power components are present in part determines if an individual will be placed in a self-medication program. Although the structure of self-medication programs may vary, the transition from nurse administration to self-administration occurs in a series of stages. Compliance packaging, written medication schedules and cues are often used to assist patients in medication management. Thus, self-medication programs are structured to be partially compensatory or educative/supportive. Continued

participation in the program is contingent upon criteria such as level of medication knowledge, level of adherence and number of errors made.

Self-medication programs have been functioning in institutions for over 20 years and were initially introduced as a means of educating patients about their medications (Collingsworth, Gould & Wainwright, 1997; Furlong, 1996). It has been theorized that self-medication programs increase adherence and knowledge while fostering independence, confidence and empowerment in medication management after discharge (Barry, 1993). After reviewing the literature, Collingsworth et al. (1997) concluded that self-medication programs do increase patient knowledge of medication regimens. As well, participation in self-medication programs was shown to enhance patient compliance in all but one of the studies in the review (Collingsworth). The review of the literature also demonstrated that self-medication programs increased independence, customized care, trust and partnership with nursing staff (Collingsworth). While maintaining independence in a self-care activity such as medication management may seem trivial, it has been shown that self-worth, self-regard, self-concept and well-being are related to older adults' ability to preserve an active role in self-care (Jirovec & Maxwell, 1993; Smits & Kee, 1992). Patients who have participated in self-medication programs have been very satisfied with the programs because of the sense of control and responsibility it gave them (Day, Moore, & Hodgins, 1998). While self-medication programs may place participants at risk for accidental or intentional overdose, it was actually far more common for patients to underdose themselves (Collingsworth).

An advantage to using the self-medication approach to determine power components and basic conditioning factors in predicting capacity for medication

management is that patients manage the medication regimens that have been prescribed to them. This approach is still limited, however, by the fact that participants may receive more support and cues to aid them in managing their medications than they would at home. Thus, using data from a self-medication program establishes characteristics of those who fail to effectively manage their medication regimens even with assistance, and such data are useful and relevant.

Being capable of self-administering medications by the time of discharge is considered success in self-medication programs. Failure in a self-medication program implies that a self-care deficit existed and therapeutic self-care demand exceeded the individual's self-care agency. Failure also implies that the magnitude of the self-care deficit was such that it could not be corrected using a partially compensatory or educative/supportive model, rather a fully compensatory model was required. Success or failure within the context of a self-medication program could be indicative of the magnitude of a patient's self-care deficit and what type of role a health care provider should assume to correct the deficit. As well, the amount of errors made by subjects while participating in self-medication programs could help to identify factors related varying levels of self-care ability within the context of a partially compensatory or educative/supportive system.

The literature in which the power components and basic conditioning factors for medication management have been assessed using simulation exercises and self-medication programs is reviewed and summarized.

2.5.1 Basic Conditioning Factors and Power Components in Simulation Exercises

Seven studies have used simulation exercises to assess the basic conditioning factors and power components associated with older adults' capacity for medication management. Descriptions of each of these studies' objectives, subjects and tasks comprising the simulation exercise are presented in Table 2.0. While the majority of studies focused on outpatients, two studies (Meyer & Schuna, 1989; Fitten et al., 1995) compared the performance of inpatients and outpatients on the simulation exercises. Study samples ranged in size from 55 to 259 subjects in total. The proportion of males in each of the study groups ranged from 20 to 100%. While several studies did include subjects under the age of 65, the mean age of study participants exceeded 65 in all studies for which the mean was reported. All simulation exercises included a variety of tasks that assessed the movement abilities and cognitive limitations factors. Meyer and Schuna (1989) and Ruscin and Selma (1996) used essentially the same simulation exercise, as did Gurland et al. (1994) and Fulmer and Gurland (1997). The simulation exercise used by Edelberg et al. (1999) was unique in that it involved the subjects' own medications and packaging. Other simulation exercises asked subjects questions about regimens with which they were unfamiliar or asked subjects to demonstrate their ability to handle packaging that they may not routinely use. In this way, Edelberg et al.'s Drug Regimen Unassisted Grading Scale (DRUGS) assessment was more realistic than the others, since the therapeutic self-care demand reflected the demand they faced with their own medication regimens. Perhaps this makes Edelberg et al.'s assessment a more valid indication of how subjects would function in the community.

Table 2.0: Study Design - Simulation Exercises

Authors (Year)	Objective(s)	Subjects	Exercises
Meyer & Schuna (1989)	③ To develop a simple and objective screening tool to assess functional ability to take medications	N=93 (53 inpatients and 40 outpatients) Sex: 96% males, 4% females Mean age 74.3 ρ 10.1	③ Responsibility for medication management ③ Ability to read prescription label ③ Ability to open and close child resistant push and turn cap on 7 dram vial ③ Ability to open and close non-child resistant cap on 7 dram vial ③ Ability to explain three times daily dosing regimen ③ Ability to remove 2 dipyramidole tablets from a 7 dram vial ③ Ability to differentiate 5 tablet colours
Ruscin & Selma (1996)	③ To identify risk factors for poor medication management capacity in older adults living in the community using a performance based instrument	N= 83 community dwellers Sex: 80% females, 20% males Mean age 79.8 ρ 8.4	③ Ability to read prescription label ③ Ability to open and close child resistant push and turn cap on 7 dram vial ③ Ability to open and close non-child resistant cap on 7 dram vial (if failed on safety cap) ③ Ability to explain three times daily dosing regimen ③ Ability to remove 2 dipyramidole tablets from a 7 dram vial ③ Ability to differentiate 5 tablet colours

Table 2.0: Study Design: Simulation Exercises (Continued)

Authors (Year)	Objective(s)	Subjects	Exercises
Edelberg et al. (1999)	③ To use the Drug Regimen Unassisted Grading Scales (DRUGS) to determine if inability to take medication correlates with cognitive impairment	N= 59 community dwellers Sex: 72% females, 28% males Mean age 84.2 ρ 5.1	③ Ability to identify medications ③ Ability to open the container in which medication is stored ③ Ability to dispense the correct number of tablets per dose ③ Ability to demonstrate correct dosing times
Fitten et al. (1995)	③ To develop an instrument to assess capacity to adhere to a medication regimen before the regimen is initiated	N=55 (20 healthy outpatients, 15 medical outpatients, 20 medical inpatients) Mean Age ③ healthy outpatients: 69.95 ρ 7.46 ③ medical outpatients: 69.33 ρ 8.71 ③ inpatients: 67.30 ρ 9.56 Sex ③ healthy outpatients: 65% female, 35% male ③ medical outpatients: 100% male ③ inpatients: 100% male	③ Ability to read and understand prescription labels and auxiliary labels ③ Ability to open five types of vials, remove appropriate number of tablets and close vial ③ Ability to understand (in terms of judgement, consequences and memory) two hypothetical medication regimens of differing degrees of difficulty

Table 2.0: Study Design: Simulation Exercises (Continued)

Authors (Year)	Objective(s)	Subjects	Exercises
Isaac et al. (1993)	③ To define a battery of tests that measure cognitive abilities necessary for medication management ③ To develop an objective measure of medication planning ability ③ To evaluate relationships between motor and cognitive function and medication management	N=20 outpatients Mean Age 71.5 ρ 5.8 Sex: 70% female and 30% male	Filled Dosett according to directions on prescription vials in order to assess ③ Ability to read prescription label ③ Ability to interpret directions ③ Ability to open 3 types of vials ③ Ability to cut pills when required for administration of correct dosage ③ Ability to plan daily dose and timing of medication
Gurland et al. (1994)	③ To develop a new test of adaptive cognitive functioning in dementia	N=259 outpatients Age 138 aged 65-74 84 aged 75-84 37 aged 85 or older Sex: 68% females and 32% males	③ Ability to learn and recall number of pills in vial (nine placebo capsules) ③ Ability to subtract three pills from the nine in the bottle ③ Ability to calculate how long the pills would last for a given dosing regimen ③ Ability to determine the days for taking medications over a 2-week period if took medication every other day ③ Ability to learn and remember the indication of a medication ③ Ability to remove 3 pills from a vial and return them to the vial ③ Ability to describe pills/vial for a certain indication

Table 2.0: Study Design: Simulation Exercises (Continued)

Authors (Year)	Objective(s)	Subjects	Exercises
Fulmer & Gurland (1997)	③ To examine the relationship between Medication Management Test score and the current responsibility for medication management	N=125 outpatients (51 cognitively impaired and 74 cognitively intact) Mean Age: 78 years (standard deviation not reported) Sex: not reported	③ Ability to learn and recall number of pills in vial (nine placebo capsules) ③ Ability to subtract three pills from the nine in the bottle ③ Ability to calculate how long the pills would last for a given dosing regimen ③ Ability to determine the days for taking medications over a 2-week period if took medication every other day ③ Ability to learn and remember the indication of a medication ③ Ability to remove 3 pills from a vial and return them to the vial ③ Ability to describe pills/vial for a certain indication

Table 2.1 summarizes the measures used to determine the basic conditioning factors and power components that influence capacity for medication management and the major findings for each simulation exercise. Findings relating to the cognitive limitations and movement abilities factors of the power components, several basic conditioning factors and therapeutic self-care demand are summarized following Table 2.1.

Table 2.1: Simulation Exercise Findings

Authors (Year)	Measures	Primary Findings
Meyer & Schuna (1989)	Cognitive Limitations Factor ③ Jacob's Cognitive Capacity Screening Examination ③ Score δ 20 suggestive of cognitive impairment Basic Conditioning Factors ③ Age, Education Other Measures ③ Managed own medications (yes or no) ③ Inpatient vs outpatient status	Cognitively intact patients more likely to be able to ③ Read prescription label ③ Remove tablets from bottle ③ Describe three times daily dosing regimen ③ Differentiate between tablet colours Cognitively intact patients more likely to manage own medications Patients who managed their own medications were more likely to be able to ③ Read prescription labels ③ Remove tablets from a bottle ③ Describe three times daily dosing regimen ③ Differentiate between tablet colours Age and education did not affect performance on the assessment Inpatients and outpatients differed only on the interpretation of a three times daily dosing regimen
Ruscin & Selma (1996)	Cognitive Limitations Factor ③ Mini-Mental State Examination (MMSE) ③ Score δ 23 suggestive of cognitive impairment Movement Abilities Factor ③ Katz Index of Activities of Daily Living ③ Score of 0 suggestive of no physical dependency Basic Conditioning Factors ③ Sex, Age Therapeutic Self-Care Demand ③ Number of medications	③ Cognitively intact patients more likely to be able to perform each and all 5 tasks correctly ③ Patients without any physical dependency more likely to be able to perform each and all 5 tasks correctly ③ Physical dependency and cognitive impairment each were statistically significant predictors of whether all tasks could be performed correctly ③ Sex, age, number of medications did not predict whether all tasks could be performed correctly

Table 2.1: Simulation Exercise Findings (Continued)

Authors (Year)	Measures	Primary Findings
Edelberg et al. (1999)	Cognitive Limitations Factor ③ Mini-Mental State Examination ③ Lawton Instrumental Activities of Daily Living (IADL) Movement Abilities Factor ③ Modified Katz Activities of Daily Living (ADL) ③ Lawton Instrumental Activities of Daily Living (IADL) ③ Timed-Up and Go (TUAG) ③ Visual impairment Motivation Factor ③ Geriatric Depression Scale (GDS) Basic Conditioning Factors ③ Social factors, Education, Sex, Age ③ Charlson Comorbidity Index Therapeutic Self-Care Demand ③ Number of medications, number of doses Other Measures ③ Medication management questions	Univariate Analysis ③ DRUGS tool score negatively correlated with age ($r=-.41$, $p < .001$) and self-reported medication management capacity (r not reported, $p=.047$) ③ DRUGS score and self-reported medication management correlated with MMSE ③ Self-reported medication management capacity associated with IADL capacity ③ Statistically significantly lower DRUGS scores for those who had assisted living arrangements ③ DRUGS score not correlated with sex, living arrangement, GDS, TUAG, number of medications, number of doses, comorbidities ③ DRUGS score not statistically significantly related to IADL or ADL scores Multivariate analysis ③ MMSE and IADL capacity only statistically significant predictors of DRUGS score
Fitten et al. (1995)	Cognitive Limitations Factor ③ MMSE	③ Statistically significant correlation ($r=.70$ and $.69$, $p < .01$) between MMSE and scenario scores ③ Sensitivity and specificity of the MMSE to identify those who could not perform the scenarios was 73% and 80%, respectively ③ Medical outpatients scored lowest on the more difficult scenario ③ No differences between groups for label reading or tests of dexterity

Table 2.1: Simulation Exercise Findings (Continued)

Authors (Year)	Measures	Primary Findings
Isaac et al. (1993)	Cognitive Limitations Factor ③ Standardized MMSE ③ Attention and concentration ③ Letter cancellation test: speed and stimuli ③ WMS mental control ③ WAID digit symbol ③ Memory: Verbal ③ WMS digit span ③ WMS logical memory: immediate and delayed ③ WMS associate learning: immediate and delayed ③ Memory: Visual ③ WMS visual reproduction: immediate and delayed ③ BVRT: correct and errors Movement Abilities Factor ③ Grip strength dominant hand ③ Finger tapping dominant hand Basic Conditioning Factors ③ Age, Sex, Education, Number and type of medical conditions Other Measures ③ Compliance: pill count and self-report	③ Poor grip strength associated with amount of time required to open vials and cutting of tablets (p-values not reported) ③ No measure of cognition was statistically significantly associated with the medication management task score ③ Statistical significance of relationships between measures and compliance not reported ③ Unexpected trend of better compliance with new medications in those who made errors on medication management task, but significance not reported, thus authors felt the simulation exercise was an inadequate proxy measure ③ Relationships between age, education, sex, number and type of medical conditions and medication management task not reported
Gurland et al. (1994)	Cognitive Limitations Factor ③ Comprehensive Assessment and Referral Interview cognitive impairment scale (CARE cognitive scale) Movement Abilities ③ Vision Basic Conditioning Factors ③ Education, Age, Sex, Cultural group	③ Statistically significant correlation between Medication Management Test (MMT) and CARE cognitive scale ($r = 0.656$, $p < .001$) ③ Medication Management Test (MMT) and dementia diagnosis ($r = .569$, $p < .001$) ③ Education and CARE cognitive scale statistically significant predictors of MMT score ($R^2 = .422$) ③ Age, sex, cultural group, vision not statistically significant predictors

Table 2.1: Simulation Exercise Findings (Continued)

Authors (Year)	Measures	Primary Findings
Fulmer & Gurland (1997)	Cognitive Limitations Factor ③ Comprehensive Mental Status Questionnaire	③ Those with cognitive impairment made more errors on the MMT than those who were cognitively intact ③ Statistically significant correlation between MMT score and caregivers' report of self-administration of medications ($r = .44$, $p < .000$) ③ Those with cognitive impairment were less likely to self-administer their medications ③ Cognitively intact patients ③ 91% of those who scored well on the MMT managed own medications ③ 9% of those who scored poorly on the MMT managed own medications ③ Cognitively impaired ③ 42% of those who scored well on the MMT managed own medications ③ 5% of those who scored poorly on the MMT managed their own medications

2.5.2 Summary of the Simulation Exercise Literature

The literature in which medication management capacity was assessed using simulation exercises demonstrated some trends in the power component factors and basic conditioning factors for medication management capacity; however, several inconsistencies across studies were observed.

The relationship between the cognition limitations factor and performance on the simulated medication management tasks was examined in each of the seven studies, with some studies using a single indicator of cognitive functioning, while others used a battery of assessments. In most studies, an association between the cognitive limitations factor and performance on the simulation exercise was identified. While different measures of cognition were used, Meyer and Schuna (1989) and Ruscin and Selma (1996) both found

that ability to perform medication management tasks correctly was affected by cognition. Further evidence of the relationship between medication management capacity and cognition was provided by Edelberg et al. (1999), Gurland et al. (1994) and Fulmer and Gurland (1997).

While five studies determined that the cognitive limitations factor medication management capacity, the Fitten et al. (1995) and Isaac et al. (1993) did not. However, it is important to note that both studies had methodological issues that may have impacted their results. First, Isaac et al. (1993) had a sample size of 20, so it is possible that they did not have the statistical power to detect a relationship when one truly existed. As well, the sample used by Isaac et al. did not include any subjects who scored below 26 on the MMSE, so it is possible that no relationship was observed due to range restriction on this variable. Fitten et al. (1995) had a methodological issue in that the baseline characteristics of the three groups differed significantly on the average number of medications, score on the MMSE and sex. Also, differences in the proportion of males and females differed amongst the three groups, which could influence the study results if sex was a predictor of capacity for medication management. Thus, overall, the evidence provided would indicate the cognitive limitations factor of the power components is associated with the ability to perform simulated medication management exercises. Only two of the seven studies failed to establish a relationship between cognition and performance on the medication management task and these two studies had distinct methodological issues.

The relationship between the movement abilities factor and medication management capacity was examined in three studies (Edelberg et al., 1999; Isaac et al.

1993; Ruscin & Selma, 1996) and again inconsistencies arose. Ruscin and Selma (1996) found a relationship between physical dependency and ability to perform all tasks correctly. Physical dependency on one or more ADL predicted ability to perform each activity comprising the simulation exercise. Similarly Isaac et al. (1993) found that poor dexterity and grip strength were associated with being unable to cut tablets and open vials, though the statistical significance of these findings was not reported. Edelberg et al. (1999) produced results in their univariate and multivariate analyses that were not only contrary to the findings of Isaac et al. (1993) and Ruscin and Selma (1996), but also inconsistent within their own study.

In Edelberg et al. 's univariate analysis it was found that DRUGS score was not related to either self-reported IADL or ADL capacity, yet in the multivariate analysis, self-reported IADL capacity was found to be a statistically significant predictor of DRUGS score. Thus, it is possible that IADL capacity had additional indirect effects through another variable or was part of a spurious relationship in the multivariate analysis. It was also found that those who had assisted living arrangements had statistically significantly lower DRUGS scores than those who did not. Intuitively, it would seem that those subjects who required assisted living arrangements would have poorer movement abilities than those who did not require assisted living arrangements. Thus, it is possible that functional capacity did indeed relate to DRUGS score. It is important to note that Edelberg et al. (1999) had some distinct methodological issues. First, the authors felt that the study sample size may have created the potential for Type II error, but did not calculate what indeed their observed power was. In addition, the DRUGS tool appeared to have a ceiling effect as the average score was 93.2 (SD=11.25)

on a tool that was scored from zero to 100. Finally, the study findings may not be generalizable to a typical elderly population, as the sample was healthy, well educated and highly functional. Thus, although some inconsistencies arose, there does appear to be evidence that the movement abilities factor of the power components is associated with medication management capacity, as the methodological issues in Edelberg et al. weaken their findings.

While Edelberg et al. (1999), Isaac et al. (1993), and Ruscin and Selma (1996) all included measures of the cognition limitations and movement abilities factors, no study reported how these measures interacted to predict performance on the simulation exercises. Some data produced in the simulation exercises did relate to this issue and produced contradictory results. For example, Meyer and Schuna (1989) found that subjects with cognitive limitations were still able to perform tasks dependent on movement abilities. Conversely, Ruscin and Selma (1996) found that cognitive limitations had a negative affect on movement abilities. Fitten et al. (1995) found that movement abilities were similar in all three groups, despite the fact that the average MMSE score was statistically significantly different across the three groups. Thus, one could conclude from the findings of Fitten et al. that cognition limitations did not impact the subjects' ability to perform tasks associated with movement abilities. However, it is important to note again that Fitten et al. did have methodological issues that may have impacted the interpretation of their study's results. Two of the three studies indicated that there may indeed be a relationship between the cognition limitations and movement abilities factors. However, it remains unclear if cognition and functional capacity interact

to predict medication management capacity due to methodological issues and the failure to use multivariate analyses to explore the possibility of an interaction.

While some studies chose to focus mainly on measures of power components (movement abilities and cognitive limitations), others included or controlled for the effects of the basic conditioning factors. No study that used age as a predictor of performance on the simulation exercise found this basic conditioning factor to be a statistically significant predictor of performance (Edlelberg et al., 1999; Gurland et al., 1994; Meyer & Schuna, 1989; Ruscin & Selma, 1996). As well, sex was not found to be a statistically significant predictor of performance in any study in which its effect was evaluated (Edelberg et al.; Gurland et al.; Ruscin & Selma). Of the studies that included education as a basic conditioning factor, only Gurland et al. found education statistically significant (Edelberg et al., Gurland et al., Meyer & Schuna). While sex, education and age did not appear to predict performance on the simulation exercises, it is still important to control for these basic conditioning factors by including them in the analysis. Thus, they should be included in future research, regardless.

Interestingly, only two studies evaluated the impact of the complexity of the subjects' medication regimens (therapeutic self-care demand) on outcome for the simulation exercises (Edelberg et al., 1999; Ruscin & Selma, 1996). While Ruscin and Selma considered only the number of medications which subjects were taking, Edelberg et al. considered both the number of medications and the number of doses. In both studies, the effect of number of medications was not significant.

2.5.3 Limitations to the Simulation Exercises

While each study had specific limitations that were identified in the previous section, some common limitations existed across studies. As previously stated, the major limitation to the simulation exercises is that the items which each assessment included may or may not reflect the processes individuals use to administer their own medications. Thus, the validity of the simulation exercises has yet to be firmly established. Similarly, the issue of reliability was not thoroughly addressed, as only three of the studies had done so (Gurland et al., 1994; Edelberg et al., 1999; Fitten et al., 1995). Next, the proportion of study subjects who were male and female did not consistently reflect the typical Canadian geriatric population in several studies. For example, in Meyer and Schuna (1989) 90% of the study sample were male, while the geriatric population is typically only 25% male. Moreover, in several studies factors such as poor vision, colour blindness and arthritis could potentially confound the results (Meyer & Schuna, 1989; Ruscin & Selma, 1996). Also, in Meyer and Schuna and Ruscin and Selma no multivariate analyses were performed, so the interaction between cognition limitations and movement abilities was not assessed. Similarly, Fulmer and Gurland (1997) failed to examine the relationship between these factors of the power components.

2.5.4 Validity of the Simulation Exercises

With the number of inconsistencies that arose, the validity of the exercises that were used to assess medication management capacity is questionable. For instance, Isaac et al. (1993) concluded that the predictive validity of their assessment was poor, as the elements of cognition necessary for performing the tasks were different than those associated with compliance. As well, Selma and Ruscin (1996) found that that 22% of

patients who were cognitively and functionally capable of performing all tasks received assistance at home in administering their medications. Another shortcoming of simulation exercises is that they do not consider that some patients may be able to administer their own medications within the context of a partially compensatory system. For example, a pharmacist may halve tablets for a patient, dispense medications in compliance packaging or use large size font and easy-open vials. Placing confidence in the findings of studies that used simulated exercises to assess medication management capacity is based on the assumption that these assessments are valid.

With this being said, concurrent validity was addressed in several studies (Edelberg et al., 1999; Fulmer & Gurland, 1997; Meyer & Schuna, 1989; Ruscin & Selma, 1996). First, Meyer and Schuna found statistically significant differences when comparing patients who managed their own medications to those who did not. Those who managed their own medications were more likely to be able to read the label, remove the tablets, interpret the three times daily dosing regimen and differentiate between tablet colour. Next, Ruscin and Selma found that those individuals who received assistance with medications in their home were 8.1 (95% CI 6.5 to 9.8) times more likely to be cognitively impaired and 15.6 (95% CI 14.1 to 17.2) times more likely to have physical dependency. These findings could be interpreted to mean that individuals with functional or cognitive impairment are in greater need of assistance with medication management. As with Ruscin and Selma, Edelberg et al. (1999) found a statistically significant association between score on their simulation exercise and self-reported medication management capacity. Finally, Fulmer and Gurland found that the MMT was predictive of the capacity to self-administer medications. Of the cognitively intact patients, 91% of

those who scored well on the MMT were responsible for medication management, while 9% of those who scored poorly were managing their own medications. Of those with cognitive impairment, 42% of those who scored well on the MMT were responsible for medication management, while 5% of those who scored poorly were managing their own medications. Discordance between score on the MMT and medication self-administration was low.

While the concurrent validity of several of the simulation exercises appears to have been addressed, the issues of content, construct and predictive validity, have not. Until then, it will remain unknown whether simulation exercises accurately predict ability to manage medications. That is why it is important to examine older adults' ability to manage medications using different methodologies, such as self-medication programs.

2.5.5 Basic Conditioning Factors and Power Components in Self-Medication Programs

A review of the literature produced only two studies that examined the relationships between basic conditioning factors and power components and outcome in self-medication programs. Table 2.2 contains a description of the study objectives, subjects and the self-medication protocols.

Table 2.2: Design of Self-Medication Studies

Authors (Year)	Objective(s)	Subjects	Self-Medication Protocol
Palmer & Dobson (1994)	To determine which aspects of memory influence ability to follow a self-medication program	N=49 inpatients from a geriatric rehabilitation unit Mean Age: 78.94 ρ 8.64 Sex: 75.5% female, 24.5% male	Stage One ③ Patient asks nurse for medications by name (content) and strength at appropriate time (timing) Stage Two ③ Patient receives 24 hour supply of medications in easy open containers ③ Patient records time medication taken and any problems or adverse effects ③ Nurse verifies medications taken within 30-45 minutes of intended dosing time Stages Three and Four ③ Not described
Patrick & Howell (1998)	To evaluate the relationship between cognition and medication management performance	N= 53 inpatients from a rehabilitation unit Age: 77.33 ρ 9.02 Sex: 66% female, 34% male	Four stages, described only as each stage reflecting greater autonomy and Stage Four being complete independence

Both studies tended to focus almost exclusively on the relationship between the cognition limitations factor and outcome. These measures and study findings relating to the cognitive limitations, basic conditioning factors and therapeutic self-care demand are outlined in Table 2.3.

Table 2.3: Measures and Findings from Self-Medication Studies

Authors (Year)	Measures	Primary Findings
Palmer & Dobson (1994)	Cognitive Limitations ③ Block Design Subset of the Neurobehavioural Cognitive Status Exam ③ MMSE Cognitive Abilities ③ Ability to remember to perform specific tasks in the future ③ Pajurkova-Wilkins Prospective Remembering Test ③ Processes of learning and remembering verbal material ③ California Verbal Learning Test was used to assess (short and long delay cued recall) ③ Perceived memory ability ③ Memory Assessment Clinics Revised Self-rating Scale Therapeutic Self-Care Demand ③ Number of medications Dependent Variables ③ Advancement from Stage One to Stage Two ③ Requesting medication on time (timing) ③ Knowing the name and dose of the medication (content)	③ No statistically significant relationship between number of medications and performance in the self-medication program 64.1% of variance in timing aspect of Stage One predicted by ③ The Block Test Design ③ California Verbal Learning Test short delay cued recall ③ Ability component of the Memory Assessment Clinics Revised Self-rating Scale 81% of the variance in the content aspect of Stage One predicted by ③ Long delay cued recall subscale of the California Verbal Learning Test ③ Block Test Design ③ Ability component of the Memory Assessment Clinics Revised Self-rating Scale Statistically significant predictors of successful advancement from Stage One to Stage Two ③ Many sub-scales of the California Verbal Learning Test ③ MMSE ③ Block Design ③ Pajurkova-Wilkins Prospective Remembering Test ③ Ability and frequency components of the Memory Assessment Clinics Revised Self-rating Scale

Table 2.3: Measures and Findings from Self-Medication Studies (Continued)

Authors (Year)	Measures	Primary Findings
Patrick & Howell (1998)	Cognitive Limitations ③ MMSE Cognitive Abilities ③ Non-verbal reasoning abilities ③ Block Design Subset of the Neurobehavioural Cognitive Status Exam ③ Delayed recall of verbal material ③ Logical Memory II ③ Visuo-spatial ability ③ Hooper Visual Organization Test ③ Verbal fluency for categorical items ③ Animal Fluency Test Motivation ③ Geriatric Depression Scale Short Form Basic Conditioning Factors ③ Age, Sex Therapeutic Self-Care Demand ③ Number of medications Dependent ③ Error ratio (number of errors/number of days on program) ③ Days to completion ③ Stage reached	③ MMSE, age and sex were not predictive of the number of errors made, stage reached and days to completion ③ Hooper VOT was the only statistically significant predictor of the stage reached and passing or failing on the program ③ Number of medications taken was the only statistically significant predictor of the error ratio ③ Relationships between days to completion and other predictors not reported

The cognitive limitations factor of the power components was supported in part by these the two self-medication studies. Palmer and Dobson (1994) found that MMSE did indeed predict the ability of individuals to advance from Stage One to Stage Two of the self-medication program. Contrary to Palmer and Dobson's (1994) findings, Patrick and Howell (1998) found that MMSE was not predictive of the stage reached. This could be perhaps due to the differences in measures. While Palmer and Dobson used MMSE to predict movement from Stage One to Stage Two of the self-medication program, Patrick and Howell assessed final stage reached as an outcome. It is possible that the MMSE discriminates between patients in the early stages of the program, but not in later stages. Thus, it would be beneficial to explore the impact of cognitive limitations on outcome in a self-medication program in future research to delineate and clarify this relationship.

Age and sex were the only basic conditioning factors used to predict the error ratio, days to completion and stage reached in the self-medication program in Patrick and Howell (1998). Neither were found to be statistically significant. Palmer and Dobson (1994) did not explore the impact of the basic conditioning factors on outcome in the self-medication program. Thus, as with the simulation literature, it is difficult to establish the importance of age and sex as basic conditioning factors in medication management from the available data. Because of the lack of evidence from the literature and to control for the impact of demographic variables on other variables, it would be important to include these variables in future research.

Palmer and Dobson (1994) did not find a relationship between therapeutic self-care demand, as determined by number of medications, and any outcome on the self-medication program. Conversely, Patrick and Howell (1998) found that the number of

medications was the only statistically significant predictor of the error ratio. Once again, contradictory findings make it difficult to conclude the whether number of medications is an accurate indicator of therapeutic self-care demand in medication management.

2.5.6 Limitations of the Self-Medication Literature

Of the two studies that have examined the predictors of success in self-medication programs, similar limitations are apparent in each study. These limitations create difficulty in interpreting the contradictory findings. One study was not particularly stronger than the other, except that possibly Patrick and Howell (1998) measured three outcomes and followed patients into further stages of the program. One weakness apparent in both studies was the lack of a clear description of the patients included in the program. For example, Palmer and Dobson (1994) did not state the inclusion and exclusion criteria for placement into the self-medication program. For Patrick and Howell (1998), placement into the self-medication program was based upon the clinical judgement of a team of rehabilitation professionals, and the criteria the team used was not explicitly stated. Aside from age and sex, one is unable to compare the general characteristics of the two study populations, so it is not possible to determine if differences in results could reflect differences in basic conditioning factors.

The issue of validity was not addressed in either study. However, the ability of individuals to self-administer their medications within the context of a self-medication program would seem to be a valid method of identifying individuals whose self-care agency fails to meet their therapeutic self-care demand, even within an educative/supportive or partially compensatory environment. It would be interesting to

follow-up with subjects who were successful within the institutional self-medication program to see if this success is carried over into the community (predictive validity).

In terms of general limitations, both studies have focused on the cognitive limitations and cognitive abilities factors and a few basic conditioning factors. The measures of cognition that have been used in these research studies may be of limited clinical relevance to community providers, due to a lack of availability of such measures outside of the institutional setting. In addition, the relationship between movement abilities and medication management capacity was not researched in the context of a self-medication program. Furthermore, neither the simulation exercise research studies, nor the self-medication research studies examined if certain domains of movement abilities (specific ADL's or IADL's) are better predictors of medication management capacity. As medication management involves both cognitive function and movement abilities, it would be valuable to determine how these abilities interact to predict medication management capacity. Moreover, as many older adults consume multiple medications, it would also be important to assess how cognitive limitations interact with therapeutic self-care demand (medication regimen complexity) to predict medication management capacity. Furthermore, the importance of the basic conditioning factors in predicting outcome in a self-medication program has not been established.

Since much of the past research into medication management capacity has involved simulation exercises, focused on univariate analysis or used predictors that may not be readily accessible in the community, there remains a need for further research that explores the complex relationships between basic conditioning factors, therapeutic self-care demand and measures of cognitive limitations and movement abilities. Neither the

simulation exercise literature, nor the self-medication program literature has produced a clear set of screening criteria that could be used by community healthcare providers to identify older adults who are at risk for difficulties with medication management and thus the consequences of poor medication management. Further research is needed in both of these areas as inconsistencies and questions of validity and reliability arose.

Chapter 3: Methods

As outlined in Chapter 2, simulation exercises and self-medication programs have both been used to explore the basic conditioning factors and power components of medication management. Of the two methodologies, the self-medication program seems to be more valid, as participants engage in self-care, as they self-administer their prescribed medication regimens. As well, the self-medication approach to determining the basic conditioning factors and power components of medication management is more congruent with the Theory of Self-Care Deficit, as the self-care operation of medication management can be assessed. For these reasons, the self-medication program approach was chosen to research a set of criteria that community healthcare providers could use to identify older adults at risk for difficulties in medication management.

After re-iterating the objectives of this study, the design used to address each study objective will be presented. The study setting and subjects will be described, as will be the Self-Medication Protocol followed at the rehabilitation hospital in which the study was set. The variables that were collected will be described and specific measures or assessments that were used will be explained. Finally, the statistical methods used to address each study objective will be outlined.

3.1.0 Objectives

The overall objective of this research project was to predict older adult's ability to manage medications using the Theory of Self-Care Deficit. The two specific objectives were to assess the basic conditioning factors and power components of medication management using (1) success or failure and (2) rates of medication errors in a self-medication program as outcome measures. The rate of errors made by subjects while on

the self-medication program was assessed during the entire course of the program, as well as error rates during the initial and final weeks on self-medication using bivariate and multivariate statistical analyses. The intent of the first study objective was to establish screening criteria to identify individuals likely to have a medication self-care deficit of such magnitude that it could not be overcome with an educative/supportive or partially compensatory intervention. The intent of the second study objective was to identify factors related to varying levels of medication self-care ability within the context of a partially compensatory or educative/supportive system. As well, the interactions between (a) movement abilities and cognition limitations and (b) complexity of medication regimens and cognition limitations were explored, as past research has failed to address these relationships.

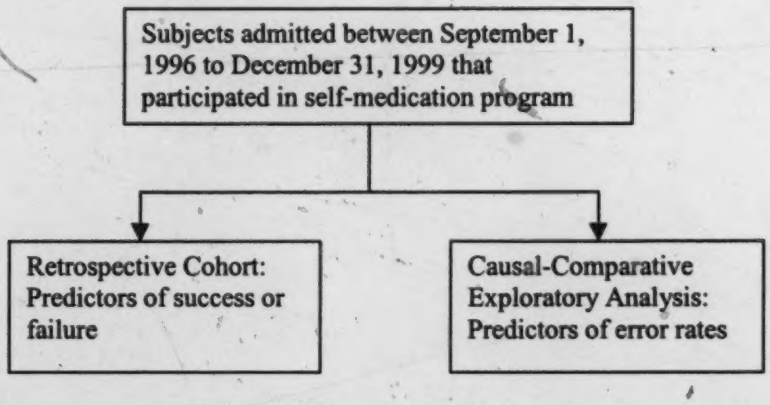
It was the aim of this study to assess basic conditioning factors and power components of the self-care agency construct using variables that would be commonly available from patient records from rehabilitation hospitals, community pharmacies or homecare assessments. Using commonly available data would negate the need for healthcare providers to perform additional assessments, while at the same time minimizing inconvenience for older adults. Significant predictor variables could be used by community providers such as pharmacists or home care nurses to screen patients for potential self-care deficits in medication management and intervene appropriately, before problems arise.

3.2.0 Design

The study design involved two analyses as outlined below in Figure 3.0. The first part of the study design was a retrospective cohort, as the study involved identifying a

single group of individuals and following them to see which ones developed the outcome of interest (Hennekens & Buring, 1987). Characteristics of patients who failed on a self-medication program in the Glenrose Rehabilitation Hospital were compared to characteristics of those who were successful in the program. Subjects were followed until the program was terminated or the subject was discharged. Subjects still on the self-medication program at the time of discharge were considered to be successful, since they had yet to make any errors that would necessitate termination. Typically, significant errors occurred early in the course of self-medication. Failure was defined as the need to terminate the self-medication program prior to discharge.

Figure 3.0: General Study Design


Subjects admitted between September 1, 1996 to December 31, 1999 that participated in self-medication program
Retrospective Cohort: Predictors of success or failure
Causal-Comparative Exploratory Analysis: Predictors of error rates

The second part of the study involved a causal-comparative exploratory analysis (Gall, Borg, & Gall, 1996). Statistically significant predictors of the error rate for the duration of the self-medication program and during the initial and final weeks while on the self-medication program were explored. Three error rates were chosen as it was anticipated that the error rate would not be constant over time. The first and last weeks on

the self-medication program were chosen as it was expected that subjects would make the most errors during the first week and the fewest during the final week (for those patients who continue on the program for a minimum of two weeks).

3.3.0 Setting and Subjects

The study was set at the Glenrose Rehabilitation Hospital in the Capital Health Region. The Glenrose is a 240-bed rehabilitation hospital that houses the Northern Alberta Regional Geriatric Program (NARG). One hundred and four beds are devoted to geriatrics on four separate units: geriatric psychiatry, geriatric assessment, geriatric medicine and geriatric cognitive impairment. NARG uses a multi-disciplinary approach to patient care involving geriatricians, a pharmacist, nurse clinicians, a physiotherapist and an occupational therapist.

At the Glenrose Rehabilitation Hospital, patients were eligible for participation in the self-medication program if they (1) were to be discharged to a setting where they would manage their own medications, (2) had a history of poor medication adherence, limited knowledge of their medications and a questionable level of comprehension or (3) had considerable medication changes or more complex medication regimens since hospitalization. In addition, it had to be unlikely that the patients' medications would change again prior to discharge. A physician's order had to be obtained to commence the program, and the patients had to be willing to participate. Patients were excluded from the self-medication program if an interdisciplinary team did not question their ability to administer medications.

After patients were deemed eligible to participate in the self-medication program, a pharmacist completed a pharmacy assessment and educated patients on the correct

usage of their medications. The education session included information on storage, device technique, adverse effects of the medications and precautions that should be observed. The information was provided verbally and in writing at a level appropriate to the patient's ability to comprehend. The pharmacist then kept a record of the medications dispensed to patients and documented in the medical record the date the program was started, general notes on patient progress, any problems that arose and the date the program was terminated, should it be required. The nursing staff also monitored patient progress and documented any errors that were made on the Self-medication Monitoring Record and/or in the nursing notes. The pharmacist determined the frequency of monitoring. Patient's ability to use the Dosett® and acceptance of this compliance aid were also noted. Prior to discharge, a pharmacist from the Glenrose Rehabilitation Hospital made arrangements with a community pharmacy to supply the patient's medications in a Dosett®. As well, the homecare needs assessment completed at discharge determined if patients required additional assistance with their medications. In this way, a supportive environment was created for patients following discharge.

The sample size was calculated from the first study objective. The least probable outcome in the retrospective cohort portion of the design was failure in the self-medication program. The size of sample required to detect a statistically significant difference between those who were successful on the program and those who were not was determined using data from Palmer and Dobson (1994). Twenty of the 49 (41%) subjects in the study did not advance from Stage One of the self-medication program to Stage Two of the self-medication program. Those subjects who did not advance had an average score on the MMSE of 21.65 (SD=3.81) while those subjects who did advance

had an average score on the MMSE of 26.75 (SD=1.76). As the outcome variable is dichotomous (success or failure) and the predictor variable continuous (MMSE), a t-test was used to determine the sample size using the following formula:

$$N = \frac{[(1/p1 + 1/p2)\, S^2 (z\Delta + zE)^2]}{E^2}$$

N=total number of subjects

p1=.41 p2=.59
$S^2 = 3.81^2$
$z\Delta$ =1.96 zE=.84
E= effect size (26.75-21.65=5.1)

If the data from Palmer and Dobson were used with an alpha=.05 and power=.80, only 18 subjects would be needed to detect a statistically significant difference between groups in the retrospective cohort. However, the effect size they found was large. If a more conservative estimate of effect size was used, the required number of subjects increased substantially as shown in Table 3.0.

Table 3.0: Number of Subjects Required According to Varying Effect Sizes

Effect Size (E)	Number of Subjects Required (N)
1.25	301
1.5	209
2	118
2.5	75
3	57

Pharmacy records at the Glenrose Rehabilitation Hospital indicated that approximately 457 patients admitted to the geriatric units between September 1, 1996 and December 31, 1999 had participated in the self-medication program. Charts of 301 of the 457 patients were randomly selected for review using a computer-generated list of random numbers. This number of subjects was consistent with an effect size of 1.25. In addition, in a regression analysis, an absolute minimum of 15 subjects per independent

variable is required (Pedhazur, 1997). Including data on 301 subjects allowed for the inclusion of about 20 variables in the analysis for the causal comparative portion of the study (Pedhazur, 1997).

3.4.0 Protection of Human Subjects

Ethics approval for the study was obtained from the University of Alberta Health Research Ethics Board Panel B. Institutional approval was obtained from the Glenrose Rehabilitation Hospital's Office of Research Services and administrative approval was obtained from the Capital Health Authority's Regional Research Administration Clinical Trials Centre. See Appendix A.

3.5.0 Data Collection

3.5.1 Data Abstraction

All data were collected through retrospective chart review using a standardized data collection form. All data were abstracted in a raw format, but then grouped or categorized for data analysis. Various portions of the chart were used to locate pertinent data and are outlined in Table 3.1. Where discrepancies existed between information obtained from healthcare provider or caregiver and patient self-report, preference was given to the healthcare provider or caregiver report for patients with cognitive impairment. Examples of the data abstraction form, Geriatric Nursing Assessment and Pharmacy Assessment can be found in Appendix B. Only data contained in the Pharmacy and Geriatric Nursing Assessments that would be used in the data analysis were abstracted.

Table 3.1: Abstracted Data and Location of Chart from which Data were Abstracted

Demographic Information	**Location in Chart**
Admission and discharge dates	Discharge summary
Reason for admission	Discharge summary
Language	Admission assessment
Residence	Admission assessment
Education	Admission assessment
Sex	Admission assessment
Age	Admission assessment
Marital status	Admission assessment
Number and type of comorbid illnesses	Discharge summary
Duration of prior institutionalization	Discharge summary from other institution
Medication Use Variables	
Number of medications	Medication administration record
Dose, dosage form, frequency and label directions for each medication	Medication administration record
Self-administered medications	Medication administration record
Recent medication changes	Geriatric nursing assessment
Self-administration of medications prior to admission	Geriatric nursing assessment
Difficulties with medication management prior to admission	Geriatric nursing assessment
System used for medication management prior to admission	Geriatric nursing assessment
Ability to read label	Pharmacy assessment
Ability to open vial	Pharmacy assessment
Responsibility for medication management prior to admission	Pharmacy assessment

Table 3.1: Abstracted Data and Location of Chart from which Data were Abstracted (Continued)

Physical Assessments	**Location in chart**
Visual impairment	Admission assessment
Hearing impairment	Admission assessment
Activities of daily living	Standardized assessment form
Instrumental activities of daily living	Standardized assessment form
Mini-Mental State Examination	Standardized assessment form
Kohlman Evaluation of Living Skills	Standardized assessment form
Functional Independence Measure	Standardized assessment form
Progress on Program	
Date of program initiation	Self-Medication Monitoring Record or nursing notes
Date of program termination	Self-Medication Monitoring Record or nursing notes
Reason for termination	Self-Medication Monitoring Record or nursing notes
Number of errors made on program (initial week, final week and overall)	Self-Medication Monitoring Record or nursing notes

All demographic and medication use variables were obtained to describe the study population. The medication use data were then used to determine each patient's Medication Complexity Index (MCI) (Kelley, 1988 in Conn, Taylor & Kelley, 1991). Physical assessment data were obtained to describe the functional and cognitive status of the study population and to serve as independent variables in the predictive analysis. Descriptions of the MCI and physical assessment data are outlined in the next section in order to clarify what each assessment measures. Selected demographic and medication use variables were also used as independent variables in the predictive analyses. Progress on the program was abstracted for use as dependent variables in the analyses.

3.5.2 Medication Complexity Index (MCI)

The MCI considers the number, frequency, additional directions that must be followed and actions required to manage medication regimens (Kelley, 1988 in Conn, Taylor & Kelley, 1991). Thus, MCI determines the therapeutic self-care demand of a medication regimen. For example, a medication that involves taking one tablet three times daily would be scored as a three, while a medication that involves taking one tablet once daily would be scored as one. If the medication must be taken three times daily with food, it would be scored as six (three points for three times daily and three points for taking the medication three times daily with food). Medications that involve devices for administration are scored with an additional point for each dosing interval. For example, if eye drops were used twice daily, the score for the medication would be four. Scores are obtained for each medication in the patient's regimen, and scores for each medication are summed to create an aggregate MCI score. Concurrent validity of the MCI was determined by experts assigning crude rankings of complexity to a number of medication regimens. The MCI score for the regimen was then compared to the rankings. Using this method, the Spearman's rank correlation was 0.89. The test-retest reliability of the MCI over a one-week period ranged from 0.80 to 1.00. Lower reliability scores for the MCI have been reported for more complex medication regimens.

The method of calculating the MCI score for oral solid dosage forms is quite clear, and the MCI appears to capture relative complexity of medication regimens, as evidenced by the Spearman's rank correlation of 0.89. However, it is not clear that the MCI accurately reflects the complexity of using certain dosage forms (such as transdermal patches and inhalers) that require several steps to administer correctly. Thus,

for medication regimens that involve devices or multiple steps for administration, the MCI may actually produce an ordinal ranking of the relative complexity of such medication regimens.

3.5.3 Mini-mental State Examination: MMSE

The MMSE was used to assess the cognitive limitations factor of the power components. The MMSE consists of 11 items, divided into two (Folstein, Folstein, & McHugh, 1975). The first section consists of verbal responses to orientation, memory and attention questions, while the second section requires subjects to follow verbal and written commands, write a sentence and copy a polygon. The maximum score on the MMSE is 30, with the point indicating cognitive impairment being 23. One method used to describe the severity of cognitive impairment categorizes unimpaired cognitive functioning as a score of 24 to 30, mild cognitive impairment as a score of 18 to 23 and moderate to severe cognitive impairment as a score of 0-17 (Tombaugh & McIntyre, 1992). The test-retest reliability of the MMSE ranges from .85 to .92 over a 24 hour period and has been reported to be .89 over a one month period (sections (McDowell & Newell, 1996). The MMSE is considered to be a screening tool for cognitive impairment, not a diagnostic device as it does not discriminate between moderate and severe dementia and may produce false positives in those with low levels of education, hearing impairment or visual impairment. As well, false positives may occur in individuals who are unable to comprehend English or are from other cultures.

3.5.4 Activities of Daily Living

Activities of daily living were used to measure the movement abilities factor of the power components. It was originally intended that activities of daily living would be

assessed using the Functional Independence Measure (FIM). The FIM consists of 18 items that assess self-care, sphincter control, mobility, communication, locomotion and social cognition; thus the FIM consists of six different subscales (McDowell & Newell, 1996). Each item is scored on a seven-point scale, with a score of seven reflecting complete independence and lower scores indicating a progressive need for additional assistance. When scored using the seven-point scale, the inter-rater reliability of the FIM ranges from .93 to .96. The content validity of the FIM was established via clinicians, while concurrent validity was established by comparing scores on the FIM to the Barthel Index, a widely used instrument with established validity and reliability.

The FIM score was abstracted when this measure was documented in the chart, but this was not common. Rather, the measure found in the chart simply rated individuals as either functional or impaired on six activities of daily living: feeding/swallowing, bathing, grooming, dressing upper extremities, dressing lower extremities and toileting. Due to the lack of availability of the FIM, it was then decided to abstract these data on ADL functional capacity as well.

3.5.5 Instrumental Activities of Daily Living (IADL's)

The ability to perform instrumental activities of daily living requires cognitive and physical functioning; thus, IADL's were used to assess the cognitive limitations and movement abilities factors of the power components. The Kholman Evaluation of Living Skills (KELS) is an evaluation of instrumental activities of daily living and assesses 18 living skills on five domains that include self-care, safety and health, money management, transportation and telephone and work and leisure (McGourty, 1988). Items are scored as '1' for needs assistance and '0' for independent, with the exception of the

work and leisure items, which are scored as .5 for needs assistance. An aggregate score of 5.5 or lower indicates that a patient is capable of living independently whereas a score of 6 or higher indicates that a patient requires assistance living in the community. Inter-rater reliability of the KELS ranges from .74 to .94.

Again, during data abstraction it was noted that only a small portion of individuals had been assessed using the KELS. Instead, individuals typically received an assessment that rated them as either functional or impaired on six instrumental activities of daily living: cooking, shopping, housework, laundry, money and transportation. Thus, it was decided to abstract these data, as well as the KELS score (though the KELS score was not used for data analysis).

3.6.0 Analysis

3.6.1 Initial Data Reduction

The number of days on the Self-Medication Program was calculated from the dates of program initiation and program termination. As well, the duration of institutionalization before admission to the Glenrose Rehabilitation Hospital and the length of stay in the Glenrose Rehabilitation Hospital before initiation of the Self-Medication Program were summed to determine the total length of institutionalization before initiating the self-medication program. The use of any cognitive enhancing medications was noted from the medications listed on the patients' medication administration record, as it was thought that cognitive enhancing medications may influence patient progress on the program. Medication regimen complexity for each subject was determined using the Medication Complexity Index (Kelley, 1988 in Conn, Taylor & Kelley, 1991) as outlined in the previous section. Medical conditions were

grouped into the general categories of (1) eyes, ears, nose and throat, (2) respiratory, (3) renal or genito-urinary, (4) neurological, (5) cardiovascular, (6) liver, (7) gastrointestinal, (8) musculoskeletal, (9) dermatological, (10) endocrine, (11) infectious disease, (12) hematological and (13) central nervous system. All remaining data were entered into a database as abstracted. A random selection of 60 subjects' data were rechecked for data entry errors.

3.6.2 Descriptive Statistics for Retrospective Cohort and Causal Comparative Analysis

All data analysis was performed using SPSS version 10.0. Treatment of variables and the appropriate descriptive statistic for each variable are outlined in Table 3.2. These data were used to describe the study population in terms of demographics, functional status, cognitive function, medication use and medication management. As well, the descriptive statistics were used to make comparisons between the study sample and the Canadian population. For some variables, both means and frequencies were calculated as the variables were treated differently in the analyses for the retrospective cohort and causal comparative analysis.

Table 3.2: Summary of Descriptive Statistics

Variable	Entry/Categorization of Data	Type of Data	Descriptive Statistic
Age	Years	Continuous	Mean
Sex	Male or female	Dichotomous	Frequency
Marital status	Married Single Widowed Divorced Common Law	Nominal	Frequency
Hearing impairment	Yes or no	Dichotomous	Frequency
Visual impairment	Yes or no	Dichotomous	Frequency
Reason for admission	Psychiatric Rehabilitation Discharge planning Assessment Rehabilitation, discharge planning, and assessment Functional decline Assessment and discharge planning Cognitive issue Awaiting placement Other	Nominal	Frequency
Education	No formal education Less than high school Some high school Completed high school Beyond high school	Ordinal	Frequency

Table 3.2: Summary of Descriptive Statistics (Continued)

Variable	Entry/Categorization of Data	Type of Data	Descriptive Statistic
Residence	House Seniors' apartment Apartment Lodge Family's home Condominium Other	Nominal	Frequency
Language	English Other	Dichotomous	Frequency
Total duration of prior institutionalization	Days	Continuous	Mean
Number of medications	Number	Continuous	Mean
Total number of self-medications	Number	Continuous	Mean
MCI	Score	Continuous	Mean
MMSE (Retrospective Cohort)	0-17 18-23 24-30	Ordinal	Frequency
MMSE (Causal Comparative)	Score	Continuous	Mean
Number of medical conditions	Number	Continuous	Mean
Cooking	Functional or impaired	Dichotomous	Frequency
Shopping	Functional or impaired	Dichotomous	Frequency
Money management	Functional or impaired	Dichotomous	Frequency
Transportation	Functional or impaired	Dichotomous	Frequency
House keeping	Functional or impaired	Dichotomous	Frequency
Laundry	Functional or impaired	Dichotomous	Frequency
Grooming	Functional or impaired	Dichotomous	Frequency
Dressing upper extremities	Functional or impaired	Dichotomous	Frequency

Table 3.2: Summary of Descriptive Statistics (Continued)

Variable	Entry/Categorization of Data	Type of Data	Descriptive Statistic
Dressing lower extremities	Functional or impaired	Dichotomous	Frequency
Feeding/swallowing	Functional or impaired	Dichotomous	Frequency
Toileting	Functional or impaired	Dichotomous	Frequency
Bathing	Functional or impaired	Dichotomous	Frequency
Type of medical condition Depression Central nervous system Eyes, ears, nose and throat Respiratory Renal or genito-urinary Neurological Cardiovascular Liver Gastrointestinal Musculoskeletal Dermatological Endocrine Infectious disease Hematological	Yes or no for each	Dichotomous for each condition	Frequency for each condition
Difficulty with medication management	Yes or no	Dichotomous	Frequency
Recent medication changes	Yes or no	Dichotomous	Frequency
Medication self-administered	Yes or no	Dichotomous	Frequency
Termination prior to discharge	Yes or no	Dichotomous	Frequency

Table 3.2: Summary of Descriptive Statistics (Continued)

Variable	Entry/Categorization of Data	Type of Data	Descriptive Statistic
Reason for termination	Discharged Errors Intentional over medication Trial discharge Failed trial discharge Will be discharged to long term care Pain Patient refusal to continue Medications required crushing Medication changes Refusing medications	Nominal	Frequency
Duration of time on self-medication	Days	Continuous	Mean
Number of errors initial week	Number	Continuous	Mean
Number of errors final week	Number	Continuous	Mean
Total number of errors	Number	Continuous	Mean

3.7.0 Study Objective One - Retrospective Cohort

As previously stated, basic conditioning factors and power components for medication management were assessed using success or failure in the self-medication program as the outcome variable. Bivariate analyses were carried out to test for statistically significant differences between those who were successful and those who failed on the self-medication program for selected variables. The assumptions for t-tests and ANOVA include (1) that values of the variable upon which the two groups are being compared are normally distributed, (2) the population variances of the two groups being compared are equal and (3) that the individual observations are independent (Glass &

Hopkins, 1996). The first two assumptions are testable whereas the final assumption is considered met if the observations in the two groups are not correlated, paired, dependent or associated, as was the case with these data. The assumption of normality can be tested using the Kolmogorov-Smirnov Test, while the assumption of homogeneity of variance can be tested using Levene's Test for Equality of Variances. In this study, the assumptions of normality and homogeneity of variance were violated by the data, so nonparametric tests (e.g. Kruskal-Wallis, Mann-Whitney and Chi -Square) were used to compare means for continuous variables.

3.7.1 Study Objective One - Bivariate Analysis

3.7.1.1 Dependent Variable

Success or failure on the self-medication program was assessed as a dichotomous dependent variable, with failure being defined as the need to terminate the program before discharge from the Glenrose Rehabilitation Hospital.

3.7.1.2 Independent Variables

It was originally intended that MMSE, KELS and FIM scores would be compared for individuals who were successful and individuals who failed on the self-medication program. However, the number of individuals whose IADL's or ADL's had been assessed using the KELS or FIM, respectively, was limited. Instead, functional capacity of individuals to perform grooming, dressing upper extremities, dressing lower extremities, cooking, shopping and money management were used as independent variables. Grooming, dressing upper extremities and dressing lower extremities were chosen as independent variables as it was thought that the ability to perform these ADL's would involve fine motor skills, similar to those needed to administer medications. For example,

dressing lower extremities involved ability to tie shoelaces and dressing upper extremities involved ability to fasten buttons. Cooking, shopping and money IADL's were chosen as independent variables because it was felt that these IADL's required planning and preparation, as would planning how to manage a medication regimen.

MMSE scores were grouped as outlined in Table 3.2. Education was treated as an independent variable as outlined in Table 3.2, as well. Other independent variables used in the bivariate analysis for the retrospective cohort included MCI, number of medications, age and number of medical conditions.

3.7.1.3 Analysis

Bivariate analyses were performed to test for statistically significant differences at the .05 level of significance between those who are successful on the self-medication program and those who failed for several predictor variables. Two tailed tests were used. Since 14 tests were carried out, the level of significance was adjusted to 0.0038 (.05/14), to maintain the overall chance of making a Type 1 Error at 5%.

Chi-square were used to test for statistically significant differences between subjects who were successful in the self-medication program and those who are not for MMSE grouping, sex, depression and education, since no cell had five or fewer observations. Ability to perform grooming, dressing upper extremities, dressing lower extremities, cooking, shopping and money management ADL/IADL's were compared for those who are successful and those who fail on self-medication also using Chi-square tests. For each test, the null hypothesis was that there was no association between the independent and dependent variables. For example, the null hypothesis for MMSE and

success or failure in the self-medication program was 'there is no association between MMSE grouping and success or failure on self-medication.'

For age, number of medical conditions, MCI and total duration of institutionalization prior to initiating self-medication, Mann-Whitney tests were used to test for differences. In each test, the null hypothesis was that there was no difference in the mean on the dependent variable for individuals who were successful and individuals who failed on the self-medication program. For example, for age, the null hypothesis was ' there is no difference in mean age for subjects who are successful on self-medication and those who fail.'

3.7.2 Study Objective One: Multivariate Analysis

Success or failure on the self-medication program was assessed as a dichotomous dependent variable, with failure being defined as the need to terminate the program before discharge.

Since the dependent variable in study objective one was dichotomous, it was intended that logistic regression would be used to determine the ability of each variable to predict success or failure in the self-medication program. These variables would then build an overall model to predict the probability of being successful in a self-medication program. The logistic regression model that was intended to be used is outlined below.

$$\log \Sigma/1-\Sigma = \Delta + EX(Sex) + EX(Age) + EX(Education) + EX(MCI) + E(MMSE) + EX(\#medical\ conditions) + EX(Cooking) + EX(Shopping) + EX(Money\ management) + EX(Dressing\ upper\ extremities) + EX(Dressing\ lower\ extremities) + EX(Depression) + EX(Total\ length\ of\ institutionalization) + EX(Shopping\ by\ MMSE) + EX(Money\ management\ by\ MMSE) + EX(Dressing\ upper\ extremities\ by\ MMSE) + EX(Dressing\ lower\ extremities\ by\ MMSE) + EX(MCI\ by\ MMSE)$$

Due to the extremely low failure rate on the self-medication program, this analysis could not be performed.

3.8.0 Study Objective Two - Causal-Comparative Analysis

3.8.1 Study Objective Two - Bivariate Analysis

3.8.1.1 Dependent Variables

Three error rates were used as dependent variables for the causal comparative analysis. The error rate was determined for the initial week in self-medication, the final week on self-medication and the entire duration on the self-medication program. The error rate for the duration of the self-medication program was defined as the number of errors made divided by the number of days in the program. The error rates for the initial and final weeks on self-medication program were determined by dividing the number of errors made by seven days. The initial week error rate was only determined for those subjects who were on the self-medication program for a minimum of 7 days, and the final week error rate was only determined for those patients who were on the self-medication program for a minimum of 14 days. Again, since the data did not meet the assumptions of normality and homogeneity of variance, a nonparametric test (Friedman Test) was used to determine that the three error rates were indeed statistically significantly different.

3.8.1.2 Independent Variables

MMSE grouping, level of education, ability to perform grooming, dressing upper extremities, dressing lower extremities, cooking, shopping, money management (yes/no) and depression (yes/no) were used as independent variables.

3.8.1.3 Analysis

Kruskal-Wallis tests were used to test for differences in each of the three error rates by MMSE grouping and level of education. For the remaining variables, Mann-Whitney tests were used to test for statistically significant differences in each of the three error rates. As there were three error rates to compare for each independent variable and 10 variables, a total of 30 tests were carried out. To maintain the risk of Type 1 Error at 5%, the level of significance was reduced to 0.0017. In each case, the null hypothesis was that there was no difference in the mean error rate for each independent variable.

3.8.2 Study Objective Two - Multivariate Analysis

3.8.2.1 Dependent Variables

It was originally intended that three separate ordinary least squares multiple regressions would be used to determine the statistically significant predictors of each error rate. The assumptions for multiple regression are (1) scores on the dependent variable are normally distributed and independent, (2) there is a linear relationship between actual and predicted scores on the dependent variable and (3) the variance of the residuals is the same for all predicted values of the dependent variable (Glass & Hopkins, 1996). The first assumption is satisfied if the residuals are normally distributed; thus, the Kolmogorov-Smirnov Test can be used for sample sizes greater than 50 (Glass & Hopkins). The second assumption can be tested by examining the mean of the residuals, which should be zero if a linear relationship exists (Glass & Hopkins). The final assumption can be tested by examining the spread of the residuals, when plotted against the predicted values of the dependent variable.

The data failed to meet the assumption of normality, as the result of the Kolmogorov-Smirnov Test was statistically significant ($p < 0.001$). As multiple regression is not robust to violation of the assumption of normality, it was decided that logistic regression would be used instead. Logistic regression does not require that the three assumptions outlined above be met. For the logistic regression analysis, subjects who made no errors during the first week, final week and entire duration of self-medication were compared to subjects who made one or more errors during the specified period. The dependent variable was coded as "0" for individuals who made no errors and "1" for individuals who made one or more errors for each period (first week, final week and overall). Thus, the dependent variable was the probability of making one or more errors during each period. In logistic regression, there is no widely accepted direct analogue of the coefficient of determination (R-Square) of an Ordinary Least Squares multiple regression; however, a number of logistic R-Square measures exist. The Cox and Snell's R-Square for a logistic regression model is difficult to interpret, as it has a maximum of less than one. The Nagelkerke's R-Square is easier to interpret as it ranges in value from zero to one. Finally, an Ordinary Least Squares R-Square can be obtained in a dichotomous logistic regression by regressing the predicted values of the logistic regression on the observed values of the dependent variable. Thus, the estimate of the proportion of variance accounted for varies depending on the estimate used.

For the group of individuals who made one or more errors, attempts were made to transform the error rates so that multiple regression analysis could be carried out for this subgroup. Unfortunately, no transformation could be found that would make any of the three error rates normally distributed.

3.8.2.2 Independent Variables

As the number of cases included in the analysis was 301, a maximum of 20 independent variables could be included in the regression model if all cases had complete data. Variables were chosen to reflect the cognition, movement abilities and motivation factors of the power components. Ability to perform ADL's and IADL's were used to address the movement abilities factors of the power components. IADL's and MMSE were selected as measures of the cognitive limitations factor of the power components. As previously stated, dressing upper extremities and dressing lower extremities were chosen as independent variables as it was thought that the ability to perform these ADL's would involve fine motor skills, similar to those needed to administer medications. Cooking, shopping and money IADL's were chosen as independent variables because it was felt that these IADL's required planning and preparation in a manner similar to planning how to manage a medication regimen.

Depression and total duration of institutionalization were selected to reflect the motivation factor of the power components, as depression is associated with motivational deficits and apathy. Prolonged institutionalization is associated with also apathy, learned helplessness and dependent behaviours. As well, several basic conditioning factors were selected and controlled for in the analyses. The basic conditioning factors assessed included age, sex and number of medical conditions. Initially, education was to be included in the model, but due to the large number of subjects for whom this independent variable was missing, it was excluded from the final model. Therapeutic self-care demand was operationalized using the MCI. Coding of the independent variables for the logistic regression analyses is outlined in Table 3.3.

Table 3.3: Coding of Independent Variables in the Logistic Regression Analyses

Variable	Coding
Age	Continuous
Sex	Male = 0 Female = 1
Depression	Yes = 1 No = 2
Number of medical conditions	Continuous
Total duration of institutionalization (days)	Continuous
MMSE	Continuous
MCI	Continuous
Dressing Upper Extremities	Impaired = 0 Functional = 1
Dressing Lower Extremities	Impaired = 0 Functional = 1
Cooking	Impaired = 0 Functional = 1
Shopping	Impaired = 0 Functional = 1
Money Management	Impaired = 0 Functional = 1

3.8.2.3 Interaction Terms

To examine the interactions between (1) cognitive limitations and movement abilities and (2) cognitive limitations and therapeutic self-care demand, a number of interaction terms were created using multiplicative functions. Interactions terms were created between (1) the two ADL's and three IADL's that were previously identified as possibly being related to skills required for medication management and MMSE, and (2) MCI score and MMSE. The ADL's used to create the interaction terms with MMSE included dressing upper and lower extremities, while the IADL's used to create the

interaction term between MMSE and IADL's included shopping, money management and cooking.

3.8.2.4 Analysis

Three logistic regression analyses were performed and odds ratios were calculated for each variable using standardized regression coefficients. Listwise exclusion of cases was used in each analysis.

First Week of Self-Medication (for subjects on self-medication for a minimum of 7 days):

$\log \Sigma/1-\Sigma = \Delta$ +EX(Sex) + EX(Age) + EX(Education) +EX(MCI) + E(MMSE) + EX(#medical conditions) + EX(Cooking) + EX(Shopping) + EX(Money management) + EX(Dressing upper extremities) +EX(Dressing lower extremities) + EX(Depression) + EX(Total length of institutionalization) + EX(Cooking by MMSE) + EX(Shopping by MMSE) + EX(Money management by MMSE) + EX(Dressing upper extremities by MMSE) +EX(Dressing lower extremities by MMSE) +EX(MCI by MMSE)

Final Week of Self-Medication (for subjects on self-medication for a minimum of 14 days):

$\log \Sigma/1-\Sigma = \Delta$ +EX(Sex) + EX(Age) + EX(Education) +EX(MCI) + E(MMSE) + EX(#medical conditions) + EX(Cooking) + EX(Shopping) + EX(Money management) + EX(Dressing upper extremities) +EX(Dressing lower extremities) + EX(Depression) + EX(Total length of institutionalization) + EX(Cooking by MMSE) + EX(Shopping by MMSE) + EX(Money management by MMSE) + EX(Dressing upper extremities by MMSE) +EX(Dressing lower extremities by MMSE) +EX(MCI by MMSE)

Entire Duration of Self-Medication (for all subjects):

$\log \Sigma/1-\Sigma = \Delta$ +EX(Sex) + EX(Age) + EX(Education) +EX(MCI) + E(MMSE) + EX(#medical conditions) + EX(Cooking) + EX(Shopping) + EX(Money management) + EX(Dressing upper extremities) +EX(Dressing lower extremities) + EX(Depression) + EX(Total length of institutionalization) + EX(Cooking by MMSE) + EX(Shopping by MMSE) + EX(Money management by MMSE) + EX(Dressing upper extremities by MMSE) +EX(Dressing lower extremities by MMSE) +EX(MCI by MMSE)

Chapter 4: Results

The overall objective of this research project was to predict older adult's ability to manage medications using the Theory of Self-Care Deficit. The two specific study objectives were to assess the basic conditioning factors and factors of the power components that predicted (1) success or failure in medication management and (2) rates of medication errors in a self-medication program.

Data were abstracted from 301 charts using retrospective chart review and entered into a database in SPSS version 10.0. The data from 60 subjects (i.e. 20% of the data) was double checked for data entry errors. The error rate was determined to be 0.35% and was considered to be acceptable. Demographic information, medication use variables and data from physical assessments will be presented first to describe the study population. Next, the results from Study Objective One will be presented. Finally, the results from Study Objective Two will be presented.

4.1.0 Sample Characteristics

4.1.1 Demographic Information and Medication Use Variables

Tables 4.0 and 4.1 and Figures 4.0 through 4.2 summarize the demographic information and medication use variables collected to characterize the study sample. Table 4.0 shows that the majority of the study sample was female, widowed, English speaking and had some high school education.

Table 4.0: Demographic Characteristics of Study Sample

Demographic Characteristics	Frequency (Percent)
Sex	
Male	67 (22.3)
Female	234 (77.7)
Marital Status	
Single	38 (12.6)
Married	64 (21.3)
Divorced	18 (6.0)
Widowed	174 (57.8)
Common Law	1 (0.3)
Missing	6 (2.0)
First Language	
English	249 (82.7)
Other	13 (4.3)
Missing	39 (13.0)
Residence Prior to Admission	
House	111 (36.9)
Condominium	13 (4.3)
Senior's Apartment	91 (30.2)
Apartment	42 (14.0)
Lodge	30 (10.0)
Family's House	9 (3.0)
Missing	5 (1.6)
Education	
No Formal Education	3 (1.0)
Less than Grade 8	41 (13.6)
Some High School	107 (35.5)
Completed High School	44 (14.6)
Post Secondary	28 (9.3)
Missing	78 (25.9)

While it was anticipated that patients on the Geriatric Rehabilitation units would be over the age of 65, this was not always the case. In fact, Table 4.1 shows that the youngest participant was 55 years of age. However, it should be noted that only four of the 301 subjects (1.3%) included in the study sample were less than 65 years of age. The average number of medications that were self-administered was 7.24 ρ 3.02 and therapeutic self-care demand was relatively high. Generally, subjects self-administered only regularly scheduled medications. If all medications that were prescribed to the study participants while in the hospital were to be included in the self-medication protocol, they would administer an average of 11.90 (ρ4.52) medications; thus, therapeutic self-care demand would be even higher.

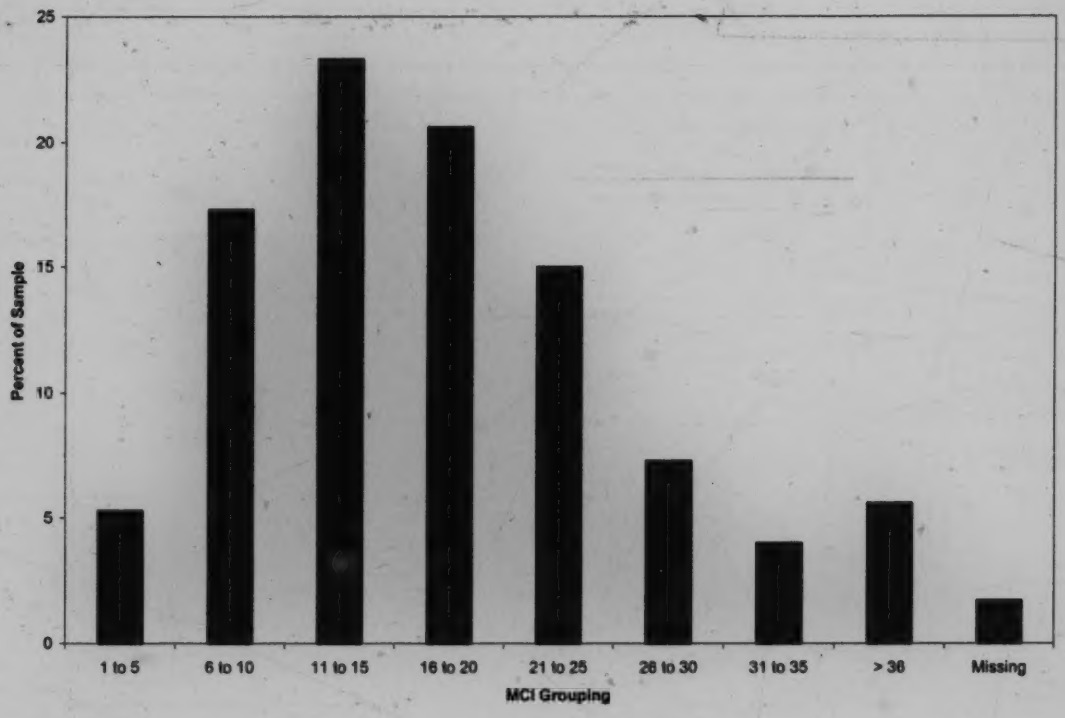
Table 4.1: Descriptive Statistics for Demographic Information and Medication Use Variables

Variable	N	Range	Mean (S.D.)
Age (years)	301	55 - 95	79.58 (6.68)
Total Duration of Institutionalization Prior to Initiation of Self-Medication (days)	297	8 - 341	46.77 (35.28)
Number of Self-Administered Medications	296	1 - 18	7.24 (3.02)
MCI[1] for Self-Administered Medications	296	1 - 103	18.15 (11.09)

1 Medication Complexity Index

The distribution of MCI scores was positively skewed (skewness = 2.490). The median MCI score was 16.00, with the interquartile range being 11.00 to 23.00). Figure 4.1 shows the percent of the study sample with in each category of MCI grouping.

Figure 4.0: Percent of Sample in each MCI Grouping

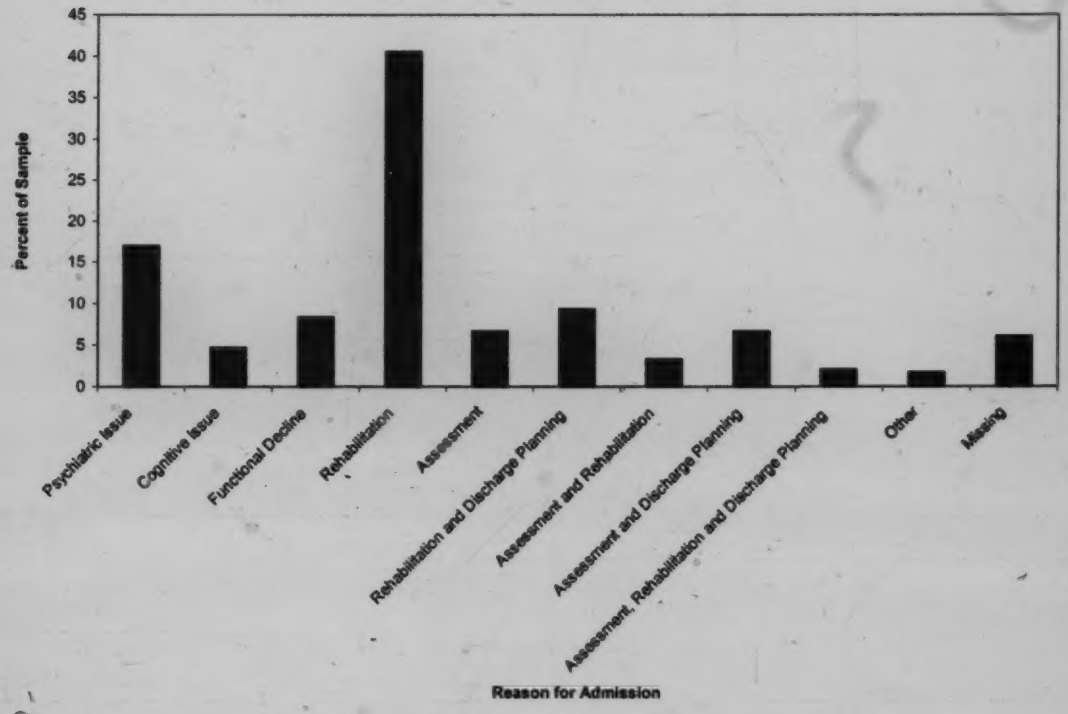


The average duration of institutionalization prior to initiation of the self-medication program exceeded one month and only 5.73% of the study sample had been institutionalized prior to initiation of the self-medication program less than 14 days. Data on recent medication changes, self-administration of medications prior to

institutionalization, system of medication management and difficulties with medication management was supposedly documented on the Geriatric Nursing Assessment. These data were missing for the majority of subjects and, consequently, were not reported. The pharmacy assessment data were available from the chart for only four subjects; therefore, data pertaining to ability to read labels and open vials were also not reported.

Figure 4.1 shows that the most common reason cited on the chart for admission to the Glenrose Rehabilitation Hospital was for rehabilitation following an event such as a fracture, myocardial infarction or stroke.

Figure 4.1: Reason for Admission to Glenrose Rehabilitation Hospital



On average, subjects had 5.95 (ρ 2.56) medical conditions. Figure 4.2 shows that the distribution of medical conditions in the study sample was positively skewed (skewness = 0.802).

Figure 4.2: Number of Chronic Medical Conditions

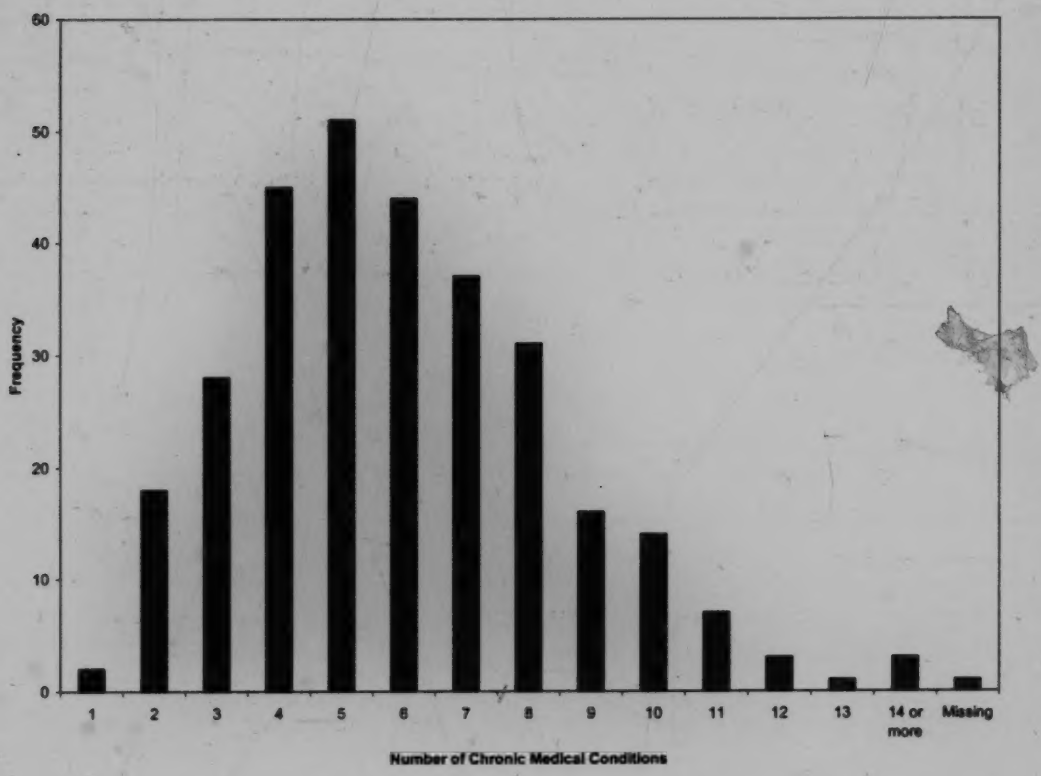
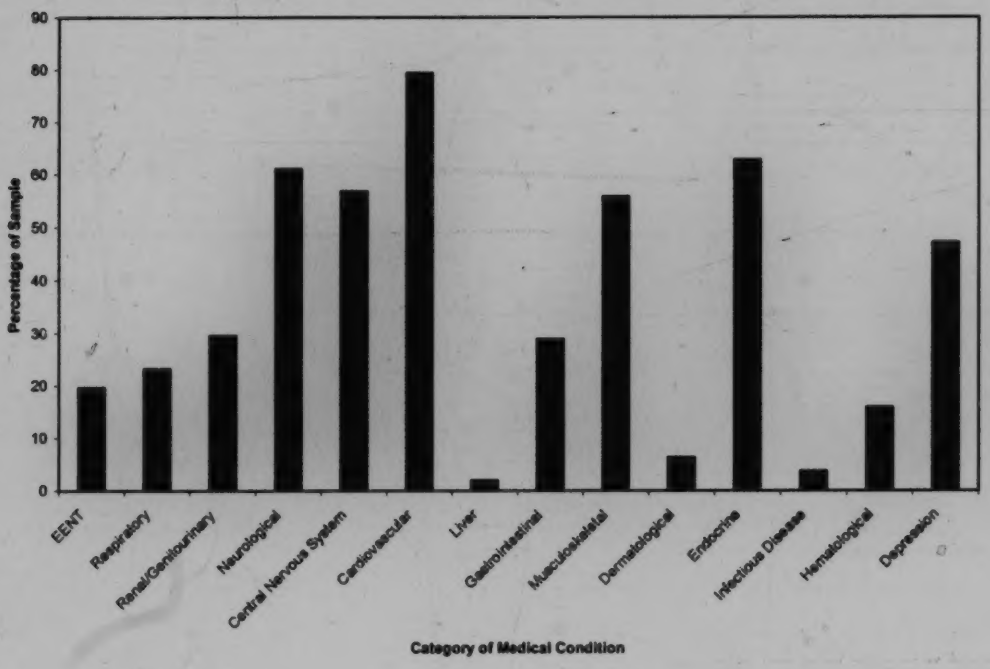


Figure 4.3 shows the percentage of subjects affected by each category of medical condition. As would be anticipated, chronic medical conditions associated with aging, such as cardiovascular, musculoskeletal and neurological disorders, affected a relatively high percentage of the sample.

Figure 4.3: Percentage of Study Sample Affected by each Category of Medical Condition



4.1.2 Physical Assessments

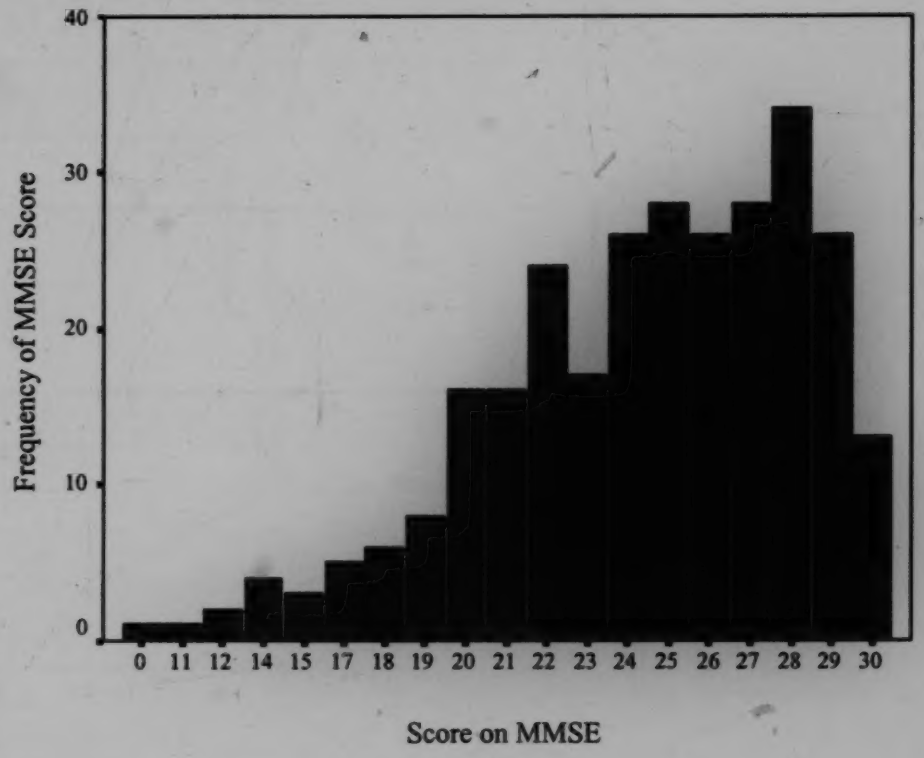
Table 4.2 summarizes the data pertaining to physical assessments performed on study subjects. These data capture the cognitive limitations and movement abilities factors of the self-care agency construct. As seen in Table 4.2, the majority of study subjects had some degree of visual and hearing impairment. Mental status, ability to perform activities of daily living, ability to perform instrumental activities of daily living and sensory impairment were assessed at admission for most study subjects. Bathing and dressing lower extremities were the activities of daily living upon which the largest proportion of study subjects had impairment. Higher levels of impairment were observed on instrumental activities of daily living as compared to activities of daily living.

Table 4.2: Psychomotor Function

Measure	Functional [Frequency (Percentage)]	Impaired [Frequency (Percentage)]	Missing [Frequency (Percentage)]
Senses			
Hearing	117 (38.9)	175 (58.1)	9 (3.0)
Vision	33 (10.9)	259 (86.0)	9 (3.0)
Activities of Daily Living			
Feeding/Swallowing	233 (77.4)	50 (16.6)	18 (6.0)
Bathing	134 (44.5)	149 (49.5)	18 (6.0)
Grooming	213 (70.8)	69 (22.9)	19 (6.3)
Dressing Upper Extremities	180 (59.8)	105 (34.9)	16 (5.3)
Dressing Lower Extremities	148 (49.2)	136 (45.2)	17 (5.6)
Toileting	174 (57.8)	105 (34.9)	22 (7.3)
Instrumental Activities of Daily Living			
Cooking	149 (49.5)	124 (41.2)	28 (9.3)
Housework	74 (24.6)	196 (65.1)	31 (10.3)
Shopping	120 (39.9)	152 (50.05)	29 (9.6)
Laundry	121 (40.2)	146 (48.5)	34 (11.3)
Money Management	129 (42.9)	139 (46.2)	33 (11.0)
Transportation	48 (15.9)	212 (70.4)	41 (13.6)

The distribution of MMSE scores is shown in Figure 4.4. While only a small percentage of participants in the self-medication program had moderate to severe cognitive impairment (5.3%), 28.9% of the sample had mild cognitive impairment. Thus, some degree of cognitive limitations did not preclude participation in the self-medication program. Perhaps the median MMSE score is more informative than the mean as the distribution of MMSE scores proved to be negatively skewed (skewness = -1.34). The median score was 25.00, with the interquartile range being 22.00 to 28.00. The mean MMSE score was 24.32 (ρ4.15).

Figure 4.4: Frequency Distribution of Scores on MMSE



Unfortunately, the Functional Independence Measure and Kohlman Evaluation of Living Skills were charted for only three and 31 individuals, respectively, so these data are not reported.

Table 4.3 compares the study sample to the Canadian population, aged 65 and older (Havens & Finlayson, 1999). The study population differed from the general population older adults on most measures.

Table 4.3: Comparison of Study Population to the Canadian Population

Variable		Study Sample	Canadian Population Aged 65 and Older[1]
Age			
65 - 74		21.9%	64.4%
75 - 84		50.8%	30.02%
85 +		25.9%	5.2%
Sex (% Female)			
65 - 74		69.7%	54.7%
75 - 84		78.4%	60.6%
85 +		84.6%	65.8%
Cognitive Impairment (MMSE 24)			
65 - 74		32.8%	2.4%
75 - 84		37.5%	11.1%
85 +		36.0%	34.5%
Impaired on IADL's			
Cooking			
65 - 74		39.3%	25.3%
75 - 84		48.1%	27.1%
85 +		45.3%	44.8%
Shopping			
65 - 74		39.3%	30.4%
75 - 84		59.8%	34.4%
85 +		62.7%	56.3%
Money Management			
65 - 74		45.8%	12.4%
75 - 84		51.9%	13.8%
85 +		56.8%	26.8%
5 or more medications		83.1%	11.0%
Education			
65 - 74	Less than high school	26.0%	Less than high school 34.4%
	Some high school	42.0%	Some high school 24.4%
	Completed high school	18.0%	Completed high school 17.1%
	Beyond high school	14.0%	Beyond high school 24.1%
75 - 84	Less than high school	19.7%	Less than high school 42.8%
	Some high school	50.4%	Some high school 22.6%
	Completed high school	23.1%	Completed high school 14.9%
	Beyond high school	6.8%	Beyond high school 19.6%
85 +	Less than high school	15.1%	Less than high school 49.9%
	Some high school	49.1%	Some high school 20.5%
	Completed high school	13.2%	Completed high school 9.5%
	Beyond high school	22.6%	Beyond high school 20.0%

1 Havens & Finlayson, 1999

4.1.3 Progress on Program

The statistics used to summarize the study subjects' progress on the self-medication program are summarized in Table 4.4. The duration of time study subjects participated in the self-medication program varied substantially. While 239 (79.40%) of study participants were on the self-medication program for at least seven days, only 120 (39.87%) study participants were on the program for at least 14 days. As anticipated, subjects made more errors during the initial week of the self-medication program than during the final week. Related to this, the error rate was also highest during the first week as compared to the final week and overall rates. This difference was statistically significant and is presented later in this chapter. Substantially fewer subjects than anticipated failed on the self-medication program (with failure being defined as the need to terminate the self-medication program prior to discharge).

Table 4.4: Descriptive Statistics Summarizing Progress on Self-Medication Program

Variable	N	Descriptive Statistic	Result
Duration of Self-Medication	301	Range	1 - 112
		Mean (S.D.)	14.42 (12.28)
Number of Errors Week One	239	Range	0 - 21
		Mean (S.D.)	2.49 (3.24)
Number of Errors Final Week	120	Range	0 - 11
		Mean (S.D.)	0.68 (1.66)
Number of Errors Total	301	Range	0 - 33
		Mean (S.D.)	3.49 (5.04)
Error Rate Week One	239	Range	0.00 - 3.00
		Mean (S.D.)	0.36 (0.46)
Error Rate Final Week	120	Range	0.00 - 1.57
		Mean (S.D.)	0.096 (0.24)
Overall Error Rate	301	Range	0.00-3.00
		Mean (S.D.)	0.30 (0.43)
Termination Earlier than Discharge (Yes or No)	301	Frequency (%)	Yes 26 (8.60) No 275 (91.40)

The reasons for termination of the self-medication program before discharge are outlined in Table 4.5. The most common reason for premature termination was due to medication errors. As an *a posteriori* test, the first week, final week and overall error rates were compared for individuals who were successful and individuals who failed on the self-medication program using the Mann-Whitney Test. Each of the three error rates were statistically significantly higher in individuals who failed on the self-medication program (week one error rate: $p = 0.001$; final week error rate: $p = 0.036$; overall error rate: $p < 0.001$). It should be noted that in some instances, it was clear that study subjects self-administered their medications in a manner that contravened the prescription

directions not due to error, rather they intentionally altered their drug regimens. These individuals were also taken off the self-medication protocol.

Table 4.5: Reason for Program Termination Earlier than Discharge (N=26)

Reason	Number of Subjects (N)
Errors	9
Confusion	5
Intentional Consumption of Extra Medication	3
Will Not Self-Administer Medications After Discharge	3
Excessive Pain	2
Medications Required Crushing	2
Refusing Medications	1
Medication Changes	1

4.2.0 Retrospective Cohort

The retrospective cohort identified patient characteristics and medication use variables that predicted success or failure in a self-medication program. This analysis differentiated individuals who required a wholly compensatory intervention to meet their therapeutic self-care demands from individuals who required a partially compensatory or educative/supportive to meet their therapeutic self-care demands. The statistical significance of several basic conditioning factors and the cognitive limitations, motivation and movement abilities factors of the power components was assessed in the retrospective cohort, using bivariate analyses.

4.2.1 Bivariate Analysis

As outlined in Chapter 3, since 14 tests were carried out, the level of significance was adjusted to 0.0038 (.05/14), to prevent elevation of the probability of Type I error. As shown in Table 4.6, no results from the Mann-Whitney tests for the four variables were found to be statistically significantly different at the alpha = 0.0038 level, when comparing those who were successful (not terminated) and those who failed (termination prior to discharge) on the self-medication program.

Table 4.6: Relationship Between Basic Conditioning Factors, Therapeutic Self-Care Demand and Program Success for Continuous Variables

Variable	N	Success[1]	Failure[1]	Significance
Age	301	80.00 (75.00-85.00)	81.00 (78.25-84.25)	0.524
MCI	296	16.00 (11.00-22.00)	20.00 (12.00-24.00)	0.322
Total Institutionalization before Initiation of Self-Medication	297	40.00 (25.00-60.00)	42.00 (22.00-63.5)	0.859
Number of Medical Conditions	300	6.00 (4.00-6.00)	6.00 (4.00-7.50)	0.822

1 Median and interquartile range are reported for information. Sum of ranks was used in the statistical analysis.

The Chi-Square Test of Independence was used to compare those subjects who were successful and those who failed on the self-medication program for the remaining independent variables. As only two study subjects had no formal education, this education category was combined with the category "less than high school". The results for the Chi-Square tests are shown in Table 4.7. Using alpha = 0.0038 to adjust for

multiple tests, MMSE category was the only statistically significant predictor of success or failure in the self-medication program.

Table 4.7: Relationship Between Basic Conditioning Factors, Power Components and Program Success for Categorical Variables

Variable	N	Success	Failure	Φ^2	Degrees of Freedom	Significance
Sex	301	77.45% Female	80.76% Female	0.151	1	0.698
Depression	300	52.19% Yes	57.69% Yes	0.288	1	0.591
Grooming	282	23.26% impaired	37.50% impaired	2.411	1	0.121
Dressing Upper Extremities	285	36.40% impaired	41.67% impaired	0.262	1	0.609
Dressing Lower Extremities	284	46.92% impaired	58.33% impaired	1.146	1	0.284
Cooking	273	44.23% impaired	59.09% impaired	1.804	1	0.179
Shopping	272	68.18% impaired	54.80% impaired	1.469	1	0.226
Money Management	268	51.01% impaired	61.90% impaired	0.920	1	0.338
Education	203	17.73% less than high school	40% less than high school	6.035	3	0.110
MMSE Category	260	28.46% mildly impaired	54.17% mildly impaired	21.660	2	<0.001

4.2.2 Multivariate Analysis

The multivariate portion of the retrospective cohort study was not carried out as the number of subjects who were terminated on the self-medication program was substantially fewer than anticipated and the data were not sufficient to perform logistic regression. As well, when the reasons for termination were examined, it was apparent that those subjects who failed on the self-medication program were a heterogeneous group. Thus, it was unlikely that one set of criteria would explain why these subjects failed on the self-medication program.

4.3.0 Study Objective Two - Causal Comparative Analysis

The causal-comparative analysis identified patient characteristics and medication use variables that predicted the rate of errors made by subjects during the entire course of the program and the initial and final weeks of self-medication. The intent of this analysis was to identify factors related to varying levels of self-care ability within the context of a partially compensatory or educative/supportive system.

The result of the Friedman Test indicated that there was a statistically significant difference between the three error rates (Chi -square = 117.4, $p < 0.001$). Thus, for objective two, the three error rates were analyzed separately using bivariate and multivariate analyses.

4.3.1 Bivariate Analysis: Week One Error Rate

To maintain the risk of Type 1 Error at 5% when performing multiple tests, the level of significance was reduced to 0.0017. The mean week one error rate was 0.36 (ρ0.46). The relationships between the basic conditioning factors, power components and

the week one error rate are shown in Table 4.8. For each activity of daily living and instrumental activity of daily living, the error rate for those subjects who were functional was compared to those who were impaired. For depression, the week one error rate for those subjects who had depression listed as a chronic condition was compared to those subjects who did not. None of the basic conditioning factors or power components were statistically significant when the conservative alpha of 0.0017 was used. Education category (with no formal education grouped into the "less than high school" category) was not significant using the Kruskal-Wallis test (Chi-Square = 1.56, df = 3, p = .668). MMSE category (0-17, 18-23, 24-30) was found to be statistically significant using the Kruskal-Wallis test (Chi-Square = 14.902, df = 2, p = .001) even when using the conservative alpha of 0.0017.

Table 4.8: Relationship Between Basic Conditioning Factors, Power Components and Week One Error Rate

Variable	N	Mean (SD)[1]	Median (Interquartile Range)	Significance
Basic Conditioning Factors				
Sex				
③ Male	56	0.36 (0.41)	0.29 (0.0-0.57)	0.343
③ Female	183	0.35 (0.48)	0.14 (0.0-0.57)	
Education				
③ Less than high school	34	0.40 (0.42)	0.29 (0.0-0.57)	
③ Some high school				0.668
③ Completed high school	84	0.39 (0.54)	0.21 (0.0-0.57)	
③ Beyond high school	38	0.31 (0.41)	0.14 (0.0-0.46)	
	22	0.34 (0.45)	0.21 (0.11-0.43)	
Power Components				
Depression				
③ Yes	129	0.33 (0.41)	0.14 (0.0-0.50)	0.700
③ No	109	0.38 (0.52)	0.29 (0.0-0.57)	
Grooming				
③ Functional	172	0.36 (0.48)	0.14 (0.0-0.57)	0.286
③ Impaired	54	0.38 (0.43)	0.29 (0.11-0.46)	
Dressing Upper Extremities				
③ Functional				
③ Impaired	149	0.35 (0.49)	0.14 (0.0-0.57)	0.166
	80	0.38 (0.41)	0.29 (0.0-0.43)	
Dressing Lower Extremities				
③ Functional				
③ Impaired	124	0.34 (0.51)	0.29 (0.0-0.57)	0.065
	104	0.38 (0.40)	0.14 (0.0-0.57)	
Cooking				
③ Functional	120	0.33 (0.40)	0.29 (0.0-0.57)	0.508
③ Impaired	99	0.39 (0.51)	0.14 (0.0-0.57)	
Shopping				
③ Functional	99	0.36 (0.50)	0.29 (0.0-0.43)	0.965
③ Impaired	120	0.34 (0.43)	0.14 (0.0-0.57)	
Money Management				
③ Functional	106	0.29 (0.40)	0.14 (0.0-0.43)	0.012
③ Impaired	111	0.42 (.50)	0.29 (0.0-0.57)	
MMSE Category				
③ 0-17	12	0.65 (0.56)	0.57 (0.29-0.96)	
③ 18-23	63	0.49 (0.50)	0.29 (0.14-0.86)	0.001
③ 24-30	156	0.29 (0.43)	0.29 (0.0-0.43)	

1 Mean and standard deviation are reported for clarity. Sum of ranks was used in the statistical analysis.

4.3.2 Bivariate Analysis: Final Week Error Rate

The average final week error rate was 0.096 (ρ0.23). The results summarizing the relationships between basic conditioning factors, power components and the final week error rate are shown in Table 4.9. No grouping variable was statistically significant with the alpha = 0.0017. MMSE category (Chi-square = 5.248, df = 2, p = 0.073) and education (Chi-square = 10.726, df = 3, p = 0.013) were not statistically significant using the Kruskal-Wallis test at the conservative alpha of 0.0017.

Table 4.9: Relationship Between Basic Conditioning Factors, Power Components and Final Week Error Rate

Variable	N[1]	Mean (SD)[2]	Median (Interquartile Range)	Significance
Basic Conditioning Factors				
Sex				
❸ Male	29	0.084 (0.16)	0.0 (0.0-0.14)	0.585
❸ Female	91	0.10 (0.26)	0.0 (0.0-0.0)	
Education				
❸ Less than high school	15	0.18 (0.33)	0.0 (0.0-0.29)	
❸ Some high school	44	0.10 (0.22)	0.0 (0.0-0.14)	0.013
❸ Completed high school	21	0 (0)	0.0 (0.0-0.0)	
❸ Beyond high school	10	0.014 (0.051)	0.0 (0.0-0.0)	
Power Components				
Depression				
❸ Yes	73	0.059 (0.16)	0.0 (0.0-0.29)	0.164
❸ No	47	0.16 (0.31)	0.0 (0.0-0.00)	
Grooming				
❸ Functional	83	0.084 (0.23)	0.0 (0.0-0.0)	0.463
❸ Impaired	32	0.14 (0.26)	0.0 (0.0-0.25)	
Dressing Upper Extremities				
❸ Functional	78	0.11 (0.27)	0.0 (0.0-0.0)	0.450
❸ Impaired	38	0.083 (0.15)	0.0 (0.0-0.14)	
Dressing Lower Extremities				
❸ Functional	65	0.081 (0.19)	0.0 (0.0-0.0)	0.381
❸ Impaired	51	0.12 (0.29)	0.0 (0.0-0.14)	
Cooking				
❸ Functional	62	0.11 (0.27)	0.0 (0.0-0.0)	0.833
❸ Impaired	48	0.083 (0.22)	0.0 (0.0-0.14)	
Shopping				
❸ Functional	53	0.10 (0.28)	0.0 (0.0-0.075)	0.575
❸ Impaired	57	0.095 (.21)	0.0 (0.0-0.14)	
Money Management				
❸ Functional	52	0.091 (0.25)	0.0 (0.0-0.0)	0.025
❸ Impaired	55	0.11 (0.24)	0.0 (0.0-0.14)	
MMSE Category				
❸ 0-17	6	0.26 (0.32)	0.14 (0.0-0.61)	0.073
❸ 18-23	23	0.17 (0.39)	0.0 (0.0-0.14)	
❸ 24-30	87	0.069 (0.19)	0.0 (0.0-0.0)	

1 Only subjects on the self-medication program for a minimum of 14 days were included in the analysis.
2 Mean and standard deviation are reported for clarity. Sum of ranks was used in the statistical analysis.

4.3.3 Bivariate Analysis: Overall Error Rate

The overall error rate was 0.30 (ρ 0.43). Table 4.10 shows the relationships between the basic conditioning factors, power components and the overall error rate. MMSE category was the only statistically significant relationship when the conservative alpha of 0.0017 was used.

Table 4.10: Relationship Between Basic Conditioning Factors, Power Components and Overall Error Rate

Variable	N	Mean (SD)[1]	Median (Interquartile Range)	Significance
Basic Conditioning Factors				
Sex				
③ Male	67	0.36 (0.55)	0.16 (0.0-0.46)	0.310
③ Female	234	0.28 (0.39)	0.14 (0.0-0.40)	
Education				
③ Less than high school	44	0.35 (0.45)	0.18 (0.0-0.55)	0.488
③ Some high school	107	0.33 (0.48)	0.20 (0.0-0.44)	
③ Completed high school	44	0.26 (0.40)	0.11 (0.0-0.39)	
③ Beyond high school	28	0.27 (0.43)	0.12 (0.0-0.33)	
Power Components				
Depression				
③ Yes	158	0.25 (0.36)	0.13 (0.0-0.39)	0.392
③ No	142	0.35 (0.49)	0.16 (0.0-0.50)	
Grooming				
③ Functional	213	0.29 (0.42)	0.14 (0.0-0.43)	0.017
③ Impaired	69	0.34 (0.51)	0.14 (0.048-0.45)	
Dressing Upper Extremities				
③ Functional	180	0.26 (0.38)	0.12 (0.0-0.42)	0.024
③ Impaired	105	0.38 (0.52)	0.23 (0.06-0.50)	
Dressing Lower Extremities				
③ Functional	148	0.27 (0.43)	0.11 (0.0-0.40)	0.320
③ Impaired	136	0.34 (0.45)	0.20 (0.05-0.45)	
Cooking				
③ Functional	149	0.25 (0.33)	0.13 (0.0-0.38)	0.572
③ Impaired	124	0.35 (0.52)	0.14 (0.0-0.49)	
Shopping				
③ Functional	120	0.27 (0.41)	0.17 (0.0-0.47)	0.008
③ Impaired	152	0.32 (0.45)	0.14 (0.0-0.44)	
Money Management				
③ Functional	129	0.22 (0.32)	0.11 (0.0-0.33)	0.203
③ Impaired	139	0.36 (0.50)	0.20 (0.0-0.50)	
MMSE Category				
③ 0-17	16	0.55 (0.59)	0.38 (0.06-0.67)	
③ 18-23	87	0.47 (0.59)	0.29 (0.07-0.57)	<0.001
③ 24-30	181	0.20 (0.28)	0.11 (0.0-0.28)	

1 Mean and standard deviation are reported for clarity. Sum of ranks was used in the statistical analysis.

4.3.4 Multivariate Analysis: Initial Week of Self-Medication

Two hundred cases were included in the logistic regression for the first week. Of these 200 cases, 36% of the cases (N=72) made no errors, while 64% (N=128) made one or more errors. Independent variables and interaction terms included in the model are reported in Table 4.11. The omnibus test of the model coefficients was statistically significant (χ^2 = 43.251, df = 18, sig = 0.001). The -2 Log Likelihood of the model was 218.117. The Cox and Snell's R-Square for the logistic regression model for week one was 0.194; however, the Nagelkerke's R-Square was 0.267. Finally, the Ordinary Least Squares R-Square was 0.186. Thus, the proportion of variance accounted for ranged from 18.6% through 26.7%, depending on the estimate used.

Overall, the model classified 71.0% of individuals correctly, but classified individuals who made one or more errors with greater accuracy than individuals who made no errors (81.3% versus 52.8%, respectively). The zero step in the logistic regression model enters only the model constant and will classify all cases according to the most frequent outcome. It this case, the most frequent outcome was making one or more errors. Thus, with only the constant entered, the model was correct for 64% of the cases. At the first step, all of the predictor variables were entered and the model correctly classified 71% of individuals. Only an additional 7% of individuals were classified correctly by including the 12 variables and six interaction terms, as 64% of individuals were already classified correctly merely by assigning all individuals to the outcome with the highest probability.

The model coefficients, odds ratios and confidence are outlined in Table 4.11. Unstandardized regression coefficients and odds ratios create difficulty in the

interpretation of the relative contributions of the independent variables, due to differences in scales. The use of unstandardized coefficients is particularly problematic for interpretation of categorical or dummy variables as one unit change (for example from "0" to "1") does not represent a natural unit of measurement. Standardized coefficients were estimated using the method proposed by Menard (1995) and are also included in Table 4.11.

Statistically significant predictors included duration of total institutionalization prior to the initiation of self-medication and Medication Complexity Index (MCI). As the coefficient for total institutionalization was positive, individuals who made no errors had shorter duration of institutionalization before the initiation of self-medication than individuals who made one or more errors. The main effect of MCI cannot be interpreted as the interaction between MCI and MMSE was statistically significant. As well, the main effects of MMSE and cooking cannot be interpreted as the interaction between these two variables was also statistically significant. As anticipated, the standardized coefficients of MCI and the interaction term for MCI and MMSE were of the largest magnitude.

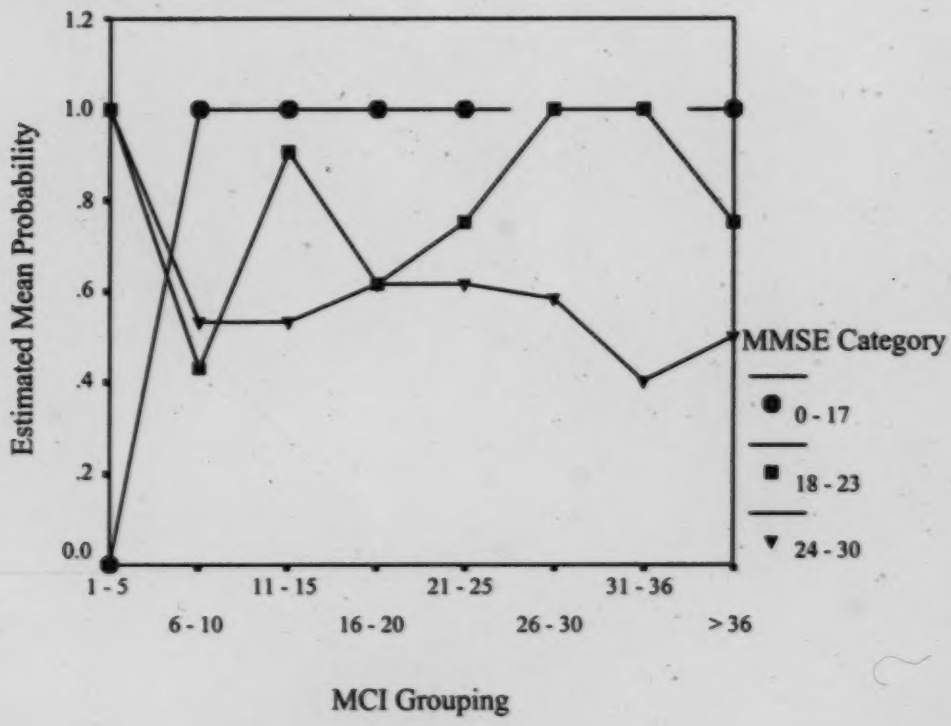
Table 4.11: Model Coefficients for Week One Logistic Regression

Variables	B[1]	P-Value	Unstandardized Odds Ratio	95% Confidence Interval for Unstandardized Odds Ratio		E[2]	Standardized Odds Ratio
				Lower Limit	Upper Limit		
Age	0.006	0.813	1.00	0.957	1.058	0.011	1.011
Sex	-0.015	0.972	0.985	0.423	2.292	-0.002	0.998
Depression	-0.449	0.197	0.638	0.323	1.263	-0.061	0.941
Number of Chronic Medical Conditions	-0.004	0.950	0.996	0.870	1.139	-0.003	0.997
Total Institutionalization (days)	-0.014	0.022	1.017	1.002	1.032	0.122	1.130
MMSE	0.116	0.459	1.123	0.826	1.525	0.123	1.131
Medication Complexity Index (MCI)	0.442	0.020	1.524	1.070	2.172	1.29	3.645
Dressing Upper Extremities	-1.082	0.790	0.339	0.000	960.8	-0.142	0.867
Dressing Lower Extremities	1.698	0.648	5.460	0.004	8059	0.231	1.260
Cooking	7.194	0.057	1131.838	0.805	2.2E6	0.976	2.653
Shopping	-1.395	0.689	0.248	0.000	230.070	-0.189	0.828
Money Management	-5.962	0.099	0.003	0.000	3.073	-.812	0.444
MCI by MMSE	-0.016	0.019	0.984	0.971	0.997	-1.26	0.284
Dressing Upper Extremities by MMSE	0.047	0.767	1.048	0.770	1.426	0.159	1.172
Dressing Lower Extremities by MMSE	-0.087	0.548	0.916	0.689	1.219	-0.305	0.737
Money Management by MMSE	0.220	0.116	1.246	0.947	1.640	0.774	2.169
Cooking by MMSE	-0.306	0.042	0.736	0.548	0.989	-1.05	0.349
Shopping by MMSE	0.078	0.572	1.081	0.826	1.415	0.271	1.312

1 Unstandardized Coefficient
2 Standardized Coefficient

Figure 4.5 is a graphic representation of the interaction between MCI and MMSE using categories for each variable to simplify the diagram.

Figure 4.5: Two Dimensional Representation of Interaction Between MMSE and MCI for Week One Logistic Regression



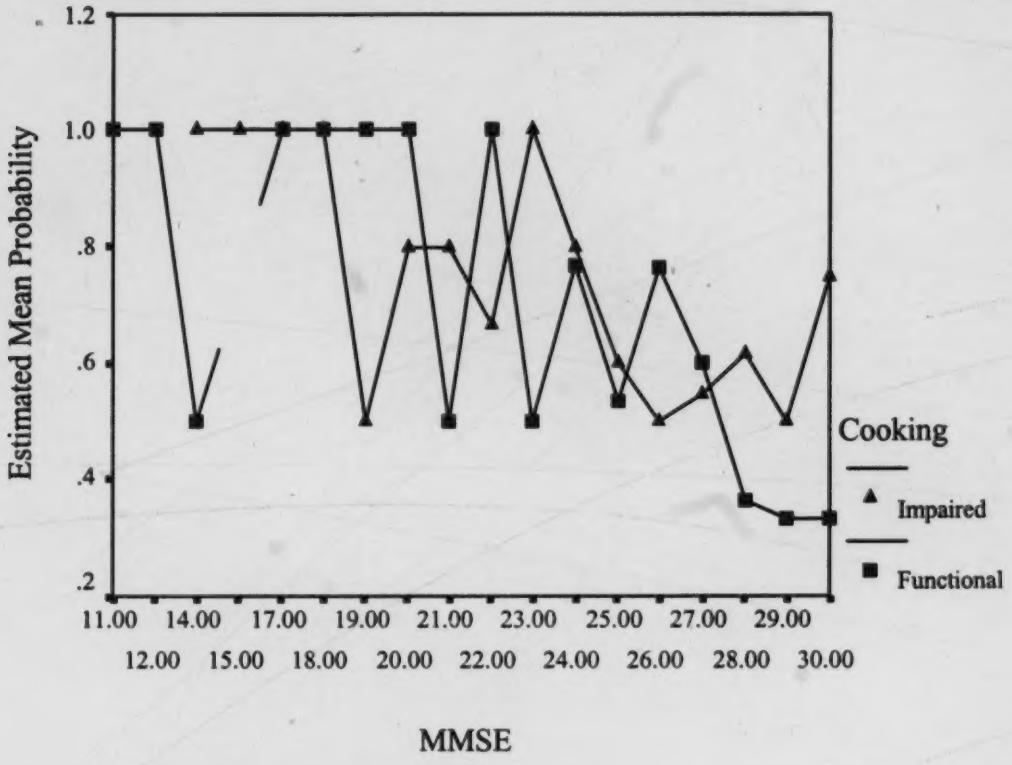
*Non-estimable means are not plotted

The probability of making one or more errors during the first week of self-medication was higher for individuals with lower MMSE scores across MCI groupings, for the most part. However, when looking at the group with moderate to severe cognitive impairment, the mean probability of making one or more errors was lower for individuals with MCI scores of less than 6, than for individuals with MCI scores of greater than 6

(0.0 versus 1.0, respectively). Next, for individuals with mild cognitive impairment, the mean probability of making one or errors was inconsistent for MCI scores of 15 or lower, but increased for the most part as MCI scores increased. Finally, for individuals with unimpaired cognition, the probability of making or more errors was largely unaffected by MCI score, when MCI scores exceeded five.

Figure 4.6 shows the interaction between cooking and MMSE. For MMSE scores less than 19, individuals whose ability to cook was impaired were more likely to make one or more errors. For MMSE scores between 19 and 27, the probability of making one or more errors was inconsistent when individuals were classified as functional or impaired on cooking ability. However, for both groups, the probability of making one or more error during the initial week of self-medication decreased for individuals with unimpaired cognition (MMSE score of 24 or higher). For scores over 27, individuals who were able to cook were more likely to be in the group that made zero errors during the first week of self-medication.

Figure 4.6: Two Dimensional Representation of Interaction Between MMSE and Cooking for Week One Logistic Regression



*Non-estimable means are not plotted

4.3.5 Multivariate Analysis: Final Week of Self-Medication

Only 100 individuals were included in the logistic regression for the final week, as only 120 study subjects were on the self-medication program at least 14 days and complete data were not available for all cases. At the end of two weeks, only 27% of the cases (N=27) made one or more error, while 73% (N=73) made no errors. The omnibus test of the model coefficients was statistically significant (χ^2 = 48.238, df = 18, sig < 0.001). The -2 Log Likelihood of the model was 68.414, indicating a better fit as

compared to the model for the first week logistic regression. The Cox and Snell's R-Square for the logistic regression model for week one was 0.383; while the Nagelkerke's R-Square was 0.556. The Ordinary Least Squares R-Square was estimated to be 0.436. Estimates of the proportion of variance accounted for ranged from 38.3% through 55.6%, depending on the estimate used.

Overall, the model classified 84.0% of individuals correctly. Thus, the final week logistic regression model classified an additional 11% of individuals correctly as compared to the percentage of individuals who would have been correctly classified at step zero. Once again, at step zero all individuals are assigned to the outcome with the highest frequency (thus the highest probability). As 73.0% of subjects had no errors, using the independent variables correctly classifies an additional 11% of cases. In contrast to the week one logistic regression model, individuals who made no errors were classified with greater accuracy than individuals who made one or more errors (91.8% versus 63.0%, respectively).

The model coefficients, odds ratios and confidence intervals are outlined in Table 4.12. Statistically significant predictors included presence of depression, MCI, MMSE and the interaction between MMSE and MCI. The coefficient for depression was positive. Since the presence of a diagnosis of depression was coded as "1" and the absence of a diagnosis of depression was coded as "2", the probability of making zero errors was higher for individuals with depression. The coefficients for MMSE and MCI were both negative. The negative coefficient for MMSE would indicate that individuals with higher MMSE scores were more likely to make zero errors during there final week on the program. Similarly for MCI, individuals with higher MCI scores (more complex

regimens) had a higher probability of making zero errors in the final week on self-medication. However, it is important to note that the main effects of MCI and MMSE cannot be interpreted as the interaction between MCI and MMSE was statistically significant. It is interesting to note that the largest standardized slopes (E's) came from money management and the interaction between money management and MMSE, yet these variables failed to reach statistical significance.

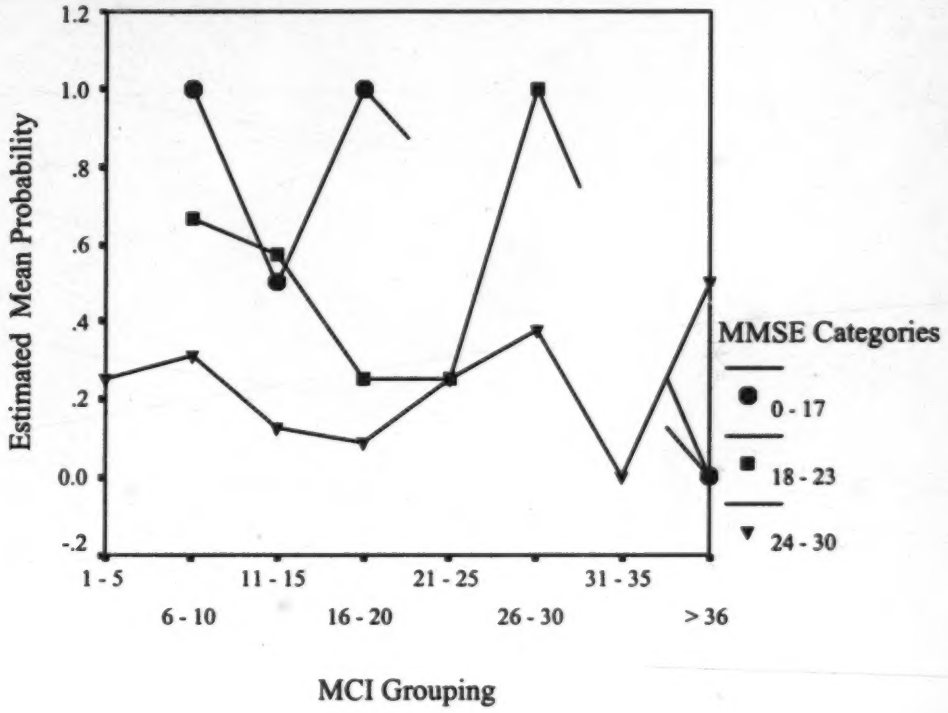
Table 4.12: Model Coefficients for Final Week Logistic Regression

Variables	B[1]	P-Value	Unstandardized Odds Ratio	95% Confidence Interval for Unstandardized Odds Ratio		E[2]	Standardized Odds Ratio
				Lower Limit	Upper Limit		
Age	-0.101	0.135	0.904	0.791	1.032	-0.159	0.853
Sex	-0.274	0.774	0.760	0.117	4.920	-0.028	0.972
Depression	2.165	0.009	8.718	1.706	44.553	0.251	1.286
Number of Chronic Medical Conditions	-0.033	0.830	0.968	0.719	1.304	-0.020	0.980
Total Institutionalization (days)	-0.009	0.529	0.991	0.965	1.018	-0.061	0.941
MMSE	-0.995	0.025	0.370	0.155	0.882	-0.883	0.414
Medication Complexity Index (MCI)	-0.881	0.022	0.414	0.195	0.882	-2.586	0.075
Dressing Upper Extremities	-4.054	0.630	0.017	0.000	2.5E5	-0.450	0.638
Dressing Lower Extremities	10.483	0.144	35719.17	0.028	4.64E10	1.223	3.399
Cooking	-7.053	0.324	0.001	0.000	1068.2	-0.818	0.441
Shopping	-18.013	0.166	0.000	0.000	1790	-2.105	0.122
Money Management	23.885	0.065	$2.36x10^6$	0.227	2.45E21	2.796	16.378
MCI by MMSE	0.037	0.019	1.038	1.006	1.071	2.725	15.261
Dressing Upper Extremities by MMSE	0.117	0.739	1.124	0.566	2.232	0.339	1.404
Dressing Lower Extremities by MMSE	-0.409	0.176	0.664	0.367	1.202	-1.246	0.288
Money Management by MMSE	-0.947	0.063	0.388	0.143	1.052	-2.960	0.0518
Cooking by MMSE	0.373	0.220	1.452	0.800	2.634	1.118	3.057
Shopping by MMSE	0.716	0.157	2.047	0.759	5.523	2.195	8.982

1 Unstandardized Coefficient
2 Standardized Coefficient

Figure 4.7 helps to interpret the interaction between MCI and MMSE, again using categories for each variable to simplify the diagram. Individuals without cognitive impairment were the least probable to make one or more errors, except for MCI scores exceeding 36. The data for individuals with severe cognitive impairment was difficult to interpret as only five individuals in the final analysis were in this group. The probability of individuals with mild to moderate cognitive impairment making one or more errors during the final week on the self-medication program varied with MCI score, decreasing as a MCI score of 25 was approached and then increasing substantially for values of 26 to 30, before decreasing once more. For individuals without cognitive impairment, the mean probability of making one or more errors remained below 0.5 and fluctuated with MCI category.

Figure 4.7: Two Dimensional Representation of Interaction Between MMSE and MCI for Final Week Logistic Regression



*Non-estimable means are not plotted

4.3.6 Multivariate Analysis: Entire Duration of Self-Medication

Of the 301 individuals, 243 were included in the logistic regression for entire duration of self-medication. Of these 239 cases, 33.5% of the cases (N=80) made no errors, while 66.5% (N=164) made one or more errors. In contrast to the first and final week logistic regression models, the omnibus test of the model coefficients was not statistically significant (χ^2 = 26.315, df = 18, sig = 0.093). The -2 Log Likelihood of the model was 282.423, indicating that of the three models, the overall model was the worst fit. The Cox and Snell's R-Square was the lowest of the three models at 0.102, as was the

Nagelkerke's R-Square, at a value of 0.142. The Ordinary Least Squares R-Square was the lowest of the three estimates (R-Square = 0.095).

Overall, the model classified 66.8% of individuals correctly and was more accurate at classifying individuals who made one or more errors with than individuals who made no errors (89.6% versus 20.0%, respectively). The ability of the model to correctly classify individuals was extremely poor, as the model only correctly classified an additional 0.3% of individuals as compared to the highest frequency observation (one or more errors = 66.5%).

The model coefficients, odds ratios and confidence intervals are outlined in Table 4.13. While the overall model was not statistically significant, ability to manage money and the interaction between money management and MMSE were statistically significant. The negative coefficient for money management would indicate that those individuals whose ability to manage their money was impaired had a higher probability of making one or more error. However, the statistically significant interaction between money management and MMSE would indicate that the effect of money management is conditional on an individual's MMSE score. The interaction between money management and MMSE and money management alone had the largest standardized E, indicating that they made a substantial contribution to the overall model that was not statistically significant.

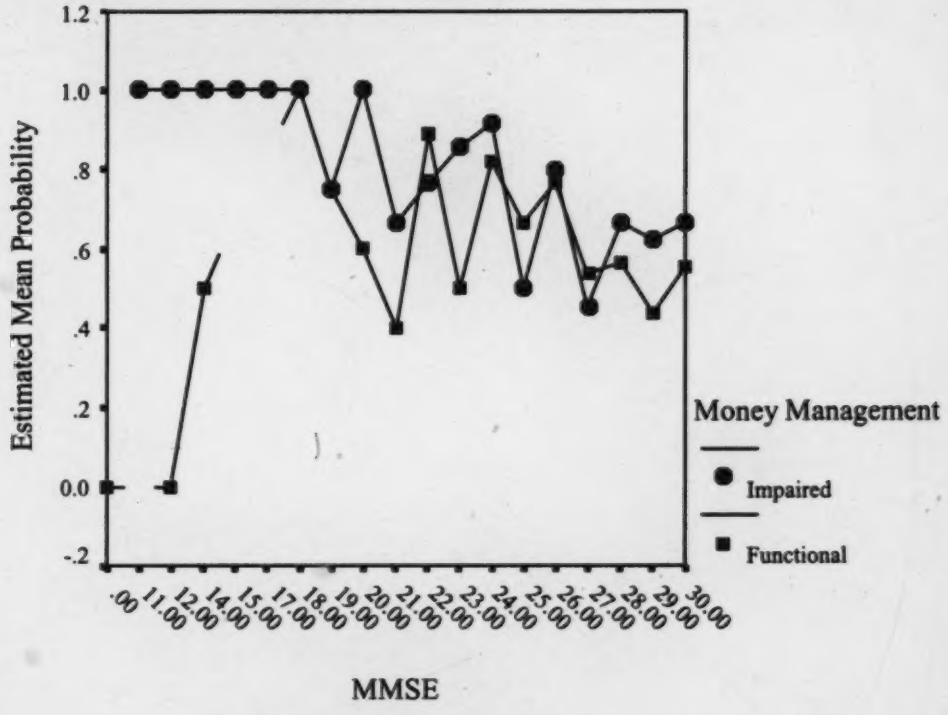
Table 4.13: Model Coefficients for Overall Logistic Regression

Variables	B[1]	P-Value	Unstandardized Odds Ratio	95% Confidence Interval for Unstandardized Odds Ratio		E[2]	Standardized Odds Ratio
				Lower Limit	Upper Limit		
Age	-0.014	0.532	0.986	0.943	1.031	-0.0329	0.968
Sex	-0.006	0.988	0.994	0.470	2.103	-8.70E4	0.999
Depression	-0.280	0.361	0.756	0.415	1.377	-0.0490	0.952
Number of Chronic Medical Conditions	-0.028	0.659	1.028	0.909	1.162	0.0255	1.026
Total Institutionalization (days)	-0.004	0.462	1.004	0.994	1.014	0.0486	1.050
MMSE	-0.087	0.457	0.916	0.728	1.153	-0.129	0.879
Medication Complexity Index (MCI)	0.042	0.713	1.043	0.835	1.302	0.159	1.173
Dressing Upper Extremities	1.424	0.631	4.154	0.012	1393	0.241	1.272
Dressing Lower Extremities	1.206	0.692	3.341	0.009	1294	0.211	1.235
Cooking	3.222	0.255	25.074	0.098	6425	0.562	1.754
Shopping	-0.214	0.928	0.807	0.008	85.121	-0.0372	0.963
Money Management	-7.117	0.009	0.001	0.000	0.176	-1.247	0.287
MCI by MMSE	-0.001	0.763	0.999	0.990	1.007	-0.0978	0.907
Dressing Upper Extremities by MMSE	-0.063	0.593	0.939	0.746	1.182	-0.272	0.762
Dressing Lower Extremities by MMSE	-0.064	0.596	0.938	0.742	1.187	-0.287	0.750
Money Management by MMSE	0.261	0.015	1.298	1.051	1.603	1.173	3.231
Cooking by MMSE	-0.130	0.254	0.878	0.703	1.098	-0.572	0.565
Shopping by MMSE	0.025	0.794	1.025	0.851	1.235	0.111	1.117

1 Unstandardized Coefficient
2 Standardized Coefficient

Figure 4.8 aids in the interpretation of the interaction between MMSE and money management. For MMSE scores less than 21, the probability of making one or more errors was higher for individuals classified as impaired on ability to manage money. For MMSE scores ranging from 22 to 26 the interaction between money management and MMSE was highly variable. At MMSE scores of approximately 27 or higher, individuals who were able to able to manage money have a lower probability of one or more errors than those individuals who were unable to manage money.

Figure 4.8: Two Dimensional Representation of Interaction Between MMSE and Money Management for Overall Logistic Regression Model



*Non-estimable means are not plotted

4.3.7 Multivariate Analysis: Summary

In summary, the model for the final week of self-medication had the best fit and accounted for the largest proportion of the variance. The model for the entire duration of self-medication failed to reach statistical significance and accounted for a small proportion of the variance in the probability of making one or more errors. Of the three models, the model for the final week on the self-medication program classified individuals with the greatest accuracy (84%). None of the three models supported age, number of medical conditions or sex as basic conditioning factors.

In the first and final weeks of self-medication the interaction between cognitive limitations (MMSE) and therapeutic self-care demand (MCI) was statistically significant. The interaction between MMSE and MCI scores showed that the probability of making one or more errors during the first week and final weeks of self-medication was generally higher for individuals with lower MMSE scores across MCI categories. The effect of MCI score on the probability of making one or more error during the first week of self-medication did not appear to be significant for individuals whose cognition was not impaired. Conversely, during the initial week of self-medication, individuals with severe cognitive impairment could manage extremely simple medication regimens without error, but could not do so once the regimen increased in complexity. For the final week of self-medication, individuals without cognitive impairment were more likely to make one or more errors when MCI scores exceeded 36, perhaps indicating when medication regimens are highly complex, individuals will still make errors, despite cognitive ability.

Some support for the motivation factor was found in the model for the first week of the self-medication program, as duration of institutionalization prior to the initiation of

the self-medication program was statistically significant. The relationship between depression and probability of making one or more errors in the final week of the self-medication program was opposite of that theorized in that individuals with a diagnosis of depression were less likely to make one or more errors than individuals without. The movement abilities factor was not strongly supported by these data, as abilities to dress upper and lower extremities were not found to be statistically significant in any of the three analyses.

Chapter 5: Discussion

After reviewing the major findings from this research project and relating these findings to the Theory of Self-Care Deficit and past research, the limitations of this study will be discussed. Next, the implications of the findings to practice and future research will be presented. Finally, relevant conclusions from these data will be drawn.

5.1.0 Major Findings

The retrospective cohort study used patient characteristics, medication use variables and the constructs of the Theory of Self-Care Deficit to predict success or failure in the self-medication program. The intent of this objective was to establish screening criteria to identify individuals likely to have a self-care deficit of such magnitude that it could not be overcome with an educative/supportive or partially compensatory intervention.

The first objective could only be achieved in part, as surprisingly few individuals (only 26 out of 301 participants or 8.6%) required that the self-medication program be terminated prior to discharge from the rehabilitation hospital. It was anticipated that an excessive number of errors would be the main reason for termination, but this was only the case for nine individuals. Each of the three error rates was indeed higher for individuals who failed on the self-medication program. The group of individuals who failed on the self-medication program were more heterogeneous than anticipated due to the various problems that lead to termination of the program. Nonetheless, univariate analyses were completed to identify differences between those who were successful and those who failed on self-medication.

Individuals who were successful and individuals who failed on self-medication did not differ on age, sex, Medication Complexity Index Score (MCI), number of chronic medical conditions or the level of education attained. Relating to the Theory of Self-Care Deficit, the findings did not support any of these demographic or medication use variables as basic conditioning factors. The lack of support of age, sex and education as basic conditioning factors is consistent with the findings of other researchers who have studied self-care agency in nursing home patients (Kasno & Jirovec, 1990; Jirovec & Kasno, 1993).

Of the three power components assessed in this study, cognitive limitations was the only factor supported by the findings. The movement abilities and motivation factors of the power components were not supported, as neither the ADL's nor the IADL's were found to be associated with success or failure on the self-medication program. This lack of support for the movement abilities and motivation factors could be in part due to measurement issues surrounding these independent variables and the dependent variable, most which will be discussed in greater detail in the limitations section of this chapter. However, it should be noted here that the since only 26 individuals failed on the self-medication program, the variance on the dependent variables was restricted. This restriction or lack of variance on the dependent variables would make it more difficult to show statistically significant differences.

The findings of the bivariate analysis for the retrospective cohort shared some consistencies with the simulation exercise and self-medication literature, but also contradicted some of the previous findings. First, past research using the simulation exercise methodology has generally demonstrated cognitive function to predict

performance. Past research in this area also identified sex, age, level of education and medication regimen complexity as predictors of performance on tasks, findings which were not supported by this study. As well, contrary to findings the simulation exercises, there was a lack of association with ADL's in this study, perhaps due to the insensitive measure of ADL's used. In addition, the lack of association between IADL's and success or failure on the self-medication program was inconsistent with the one simulation exercise that had addressed this relationship.

One finding of the retrospective cohort that was consistent with past research using the self-medication methodology was that cognition, as measured by the MMSE, was found to have an important association with outcome on the self-medication program. Another finding consistent with past research using the self-medication methodology was the lack of support of medication regimen complexity, as measured by the MCI, as a predictor of success or failure. Past research demonstrated that medication regimen complexity did not predict advancement from the first to second stage of a self-medication program (Palmer & Dobson, 1994).

Unfortunately, the multivariate analysis of the retrospective cohort portion of the study could not be carried out as the number of individuals who failed on self-medication was much lower than anticipated. Thus, the degree to which an overall model consisting of the thirteen variables could identify individuals who had a high probability of failure on a self-medication program was not established from these data. The first objective of the study was largely unmet as a result of the low failure rate, though it appeared from the bivariate analysis that there was an association between inability to self-administer medications and cognitive impairment, even in the context of a partially compensatory or

educative supportive system. Furthermore, because a multivariate analysis was not possible, potential interactions between independent variables could not be assessed.

The second study objective was to identify patient characteristics, medication use variables and constructs of the Theory of Self-Care Deficit that predicted participants' rates of errors over the entire course of the program and during the initial and final weeks of self-medication. As anticipated, the error rates differed between the first and final weeks on the self-medication program, with individuals making the greatest number of errors during the initial week. As well, the overall error rate differed from the first and final weeks. While the overall error rate may not seem to be as informative as the first and final weeks, the advantage of using it was that all individuals who participated in the self-medication program could potentially be included in the analyses. The first and final week error rates only included individuals who were on the self-medication program at least seven and 14 days, respectively. Thus, these analyses excluded individuals who had shorter stays in the rehabilitation hospital or who initiated the self-medication program close to their discharge dates.

The second study objective was met with some success. The multivariate analysis revealed relationships of higher complexity between predictor variables and differentiated individuals with no self-care deficit from individuals with self-care deficits of varying magnitudes.

As with the retrospective cohort, the bivariate and multivariate analyses of the causal comparative portion of the study did not lend support to the basic conditioning factors of the Theory of Self-Care Deficit. Age, sex, education and number of medical

conditions did not predict any of the three error rates or the probability of making one or more errors during the three periods of self-medication.

The significance of MCI as a measure of therapeutic self-care demand was analyzed in the multivariate analysis, and its effect was conditional on the cognitive limitations factor of the power components of the self-care agency construct. In the model for the initial and final weeks on the self-medication program, MCI was a statistically significant predictor, though this main effect could not be interpreted due to an interaction with the cognitive limitations factor (MMSE). The interactions for the first and final weeks were similar, in that individuals with moderate to severe cognitive impairment had the highest probability of making one or more errors, despite MCI score. As well, in both interactions, the probability of individuals with mild cognitive impairment making one or more errors increased once MCI scored exceeded a value of approximately 21 to 25.

All three of the power component factors included in the causal-comparative analysis were supported to some degree, although no factor was uniformly supported by all of the multivariate or bivariate analyses. Overall, the degree to which cognition was important was conditional on other variables in the multivariate analysis, one of which was a measure of therapeutic self-care demand (MCI score), while the other two were measures of the movement abilities and cognitive limitations factors (cooking and money management). In the bivariate analysis, such relationships could not be determined. The outcome of the interaction between ability to cook and MMSE for the first week of self-medication fluctuated substantially with MMSE score, but two generalizations can be drawn. The first generalization was that the probability of making one or more errors

during the initial week of self-medication was lower for individuals without cognitive impairment, regardless of ability to cook. The second generalization was that when considering individuals with the lowest MMSE scores, individuals whose ability to cook was impaired had a higher probability of making errors as compared to individuals who were able to cook.

Ability to mange money and an interaction between MMSE and money management were statistically significant predictors in the multivariate analysis for the entire duration of self-medication, though the main effect for money management was impossible to interpret. Individuals who were unable to manage money had a greater likelihood of making one or more errors over the entire duration of self-medication for MMSE scores lower than about 21. This relationship was not sustained for scores greater than 21, indicating that impaired ability to manage money was not important in predicting probability of making an error, particularly for the MMSE scores exceeding 27. Thus, the importance of ability to manage money was conditional on the degree to which individuals were cognitively impaired.

Support for the movement abilities and motivation factors predicting error rates was scant. Since the IADL's encompass both movement abilities and cognition, it cannot be concluded that findings for ability to cook and manage money lends support to the movement abilities factor of the theory. As well, both IADL's interacted with the cognitive limitations factor. The motivation factor was supported during the first week of self-medication in the multivariate analysis, as duration of institutionalization before initiating the self-medication program was statistically significant. The usefulness of depression as a measure of motivation was questionable. The relationship between

depression and probability of making one or more errors in the final week of the self-medication program was the opposite of that theorized. Individuals with a diagnosis of depression were less likely to make one or more errors than individuals without. This finding could be in part attributed to the manner in which depression was operationalized. Depression was defined as the individual having a diagnosis of depression at the time of admission. Thus, individuals with the diagnosis were not necessarily symptomatic and individuals without the diagnosis could have become depressed, whether diagnosed or not, during their stay, creating the potential for misclassification on this variable.

The multivariate analysis allowed for the overall explanatory power of the Theory of Self-Care Deficit (as operationalized by the variables of this study) to be determined. The ability of the model to account for the variance in the probability of making no errors versus making one of more error varied between the three analyses. Using the most conservative estimate, the model for the entire duration of self-medication accounted for 9.5% of the variance and was not significant. Thus, it does not seem reliable or informative to explore the total number of errors that an individual made across the entire duration of the self-medication program, since self-care agency seemed dynamic across the three periods. The models for the initial and final weeks of the self-medication program were both statistically significant and accounted for 18.6% and 43.6% of the variance, respectively, when using the most conservative estimates. Of the three models, the model for the final week on the self-medication program classified individuals with the greatest accuracy (84%). Even though it was not fully operationalized, the Theory of Self-Care Deficit did account for some of the variance in medication management capacity.

Overall, it seemed that the results of the causal comparative analysis provided the strongest evidence. None of the basic conditioning factors included in the bivariate and multivariate analyses were statistically significant. The support for movement abilities as a factor of the power components was scant, as no ADL was significant in the bivariate and multivariate analyses and the IADL's reflected a composite of cognitive and physical abilities. Cognitive limitations did appear to be important, but only in the bivariate analysis or through interactions with other variables in the multivariate analysis. Finally, the support for the motivation factor of the power components was also limited as the effect of depression was opposite of what was theorized and total duration of prior institutionalization was only supported in one of the three logistic regressions.

The findings of the causal comparative analysis share some similarities with past research, but as with the retrospective cohort, a number of inconsistencies arose. The majority of the simulation exercise studies examined the relationships between independent variables and task performance using exclusively bivariate analyses. Similar to past research using simulation exercises and self-medication programs, a relationship between cognitive function and ability to manage medications was supported by the bivariate analysis. Notably, statistically significant associations were found between cognition and the outcome measure in the bivariate analyses of both the retrospective cohort and causal comparative portions of this study.

Contrary to past research that used bivariate analyses, ability to perform any of the three ADL's could not predict the three error rates. There was consistency between the bivariate analyses of the retrospective cohort and causal comparative portions of this study, as neither analysis established a relationship between ADL performance and

outcome in self-medication. The lack of relationship between error rates and ability to perform IADL's in the bivariate analysis contradicted the findings of the one simulation exercise that assessed this relationship. This lack of a relationship was consistent with the causal comparative portion of the study. The effectiveness of education at predicting ability to perform simulation exercises produced was reported in only one simulation exercise and was found to be statistically significant; thus, the finding that education was not a statistically significant predictor of any of the three error rates contradicts past research.

Three studies in the past have used multivariate analysis to explore the predictors of ability to manage medication regimens, one using the simulation exercise approach, the other two the context of self-medication programs. The lack of significance of age and sex in any of the three logistic regressions in this study is consistent with the findings of past researchers, using either of the two methodologies (Eldelberg et al., 1999; Patrick & Howell, 1998). The effect of medication regimen complexity (as measured by number of medications and number of doses) in past research has been inconsistent. The one study that explored this relationship in a self-medication program found that number of medications predicted the error ratio (Patrick & Howell, 1998). The results of this research project were similar, though the effect of medication regimen complexity was conditional on cognitive function. Eldelberg et al. (1999) found MMSE and ability to perform IADL's to be the only statistically significant predictors of score on their simulation exercise; however, the interaction between these variables was not considered. To some extent the findings from this research project are similar in that MMSE and two

IADL's were statistically significant in at least one analysis, though the effects of these variables were conditional on each other.

5.2.0 Research Implications

While this research study was useful in exploring the relationships between basic conditioning factors, therapeutic self-care demand, the power components of the self-care agency construct and the ability to self-administer medications, the explanatory power of the multivariate models was relatively low. There remains a need to explore these relationships further. Possible reasons for this low explanatory power could be attributed to the manner in which several of the independent variables were measured, the exclusion of variables that may be of importance to predict ability to self-administer medications, inability to correctly model relationships due to the method of analysis used and lack fit between the behaviour being measured and the model itself.

Difficulties arose with several of the measures used in the study, as the study was retrospective and measures that were already documented in the patient records were used to operationalize the theoretical framework. While it was the intent of this study to use independent variables that would be readily available from a rehabilitation hospital or homecare assessment, this may have not been the best approach to take initially. An alternate approach would be to use more precise, sensitive and valid measures to first establish relationships did indeed exist between variables such as cognition, IADL's, ADL's, apathy, depression and ability to manage medications. Once these relationships were established with a degree of confidence, then an attempt could be made to replace these measures with simpler, more easily accessible measures. More variance in the measures would result using this approach.

It was originally intended that the Kohlman Evaluation of Living Skills and the Functional Independence Measure would be used to assess ADL's and IADL's, respectively, but these data were missing from most charts. Instead, a yes or no measure of ability to perform six ADL's and six IADL's was used. As outlined in the methods section, individuals were rated as either functional or impaired; thus, this measure did not allow for varying degrees of limitation or disability. This measurement issue may have attenuated relationships with the dependent variables in all analyses.

As well, the measures of motivation used included depression and total duration of institutionalization before starting the self-medication program. As mentioned previously, the manner in which depression was measured could have been problematic and may have lead to misclassification. Total duration of institutionalization was the sum of the number of days in the Glenrose Rehabilitation Hospital before self-medication was started and the number of days in acute care for transfer patients. It has been shown that 14 days of institutionalization may be the threshold value for induced dependence in institutionalized individuals. Only 7.7% of this sample was institutionalized for 14 days or less before initiating self-medication. Thus, it is possible that the majority of the subjects would have displayed some degree of induced dependence. Lack of variance in motivation could reduce the effectiveness of this variable in the regression analysis.

One potential issue in measurement of the independent variables arose from the manner in which patient assessments were documented in the rehabilitation hospital. Physical and cognitive assessments were typically documented upon admission to the hospital and not throughout the hospital stay. This may have been an issue in measuring MMSE, ADL's, IADL's and depression, as there would be potential for a substantial time

lapse between when these items were assessed and when the self-medication program was started. One would anticipate that this lag time could have the most significant impact on the analyses performed for the final week on the self-medication program. It should be noted that functional status upon admission to rehabilitation facilities has been shown to influence outcome at discharge; thus, the degree to which some of these variables are mutable may be small (Resnick & Daly, 1998). As well, the 30 day test-retest reliability of the MMSE had been shown to be 0.89 (McDowell & Newell, 1996).

Another possible measurement issue in this study comes from the use of the MMSE to assess cognition. It is known that the validity of MMSE can be threatened by a number of factors, two of which are education and language. Education could not be controlled in the multivariate analysis, as this variable was missing for a large number of subjects. It is not known if language barriers were an issue since first language was missing for 13% of the sample. It should be noted that English was the first language of 83% of the sample and 95% of the subjects whose first language was reported.

Other issues in measurement related to the dependent variables. It is likely that success or failure on the self-medication program was accurate since it was clearly noted on the self-medication monitoring sheet and required that a new medication administration record be produced once the program was terminated. Thus, premature termination could be verified from two sources. One potential source of error in determining success or failure in the self-medication program could have arisen from individuals being discharged before they had the opportunity to fail on the program; thus, the success rate may have been artificially high. An alternate explanation for the extremely low failure rate could be that individuals selected for the self-medication

program were not likely to fail. It is possible that individuals for whom the interdisciplinary team had no reason to question their ability to administer medications were still included in the program, despite this being listed as an exclusion criterion for the program.

The low failure rate could also be explained by the need to get consent from the individuals themselves and from their doctors. Thus, if the team selected a patient for participation whose ability was questionable, the patient's family physician could still refuse to sign the order allowing the patient to participate. As well, if individuals did not have the self-efficacy, confidence, motivation or perceived self-care agency to participate in the program, they could refuse to give consent.

The potential for measurement error in determining the number of self-medication errors was also apparent and could have arisen from two sources. First, the number of errors was tracked by nursing staff on a flow sheet, with the frequency of monitoring determined by the pharmacist. Often, the frequency with which the pharmacist intended the patient be monitored and the actual frequency of monitoring differed. As well, it was evident that when some patients went without making errors for a certain length of time, monitoring was no longer documented as thoroughly. Time constraints may have been an issue in documentation of the monitoring that occurred. The second issue in measuring the number of self-medication errors was that errors of both omission and commission were abstracted merely as errors and grouped together in the analysis. It would seem that the reasons for these errors would differ and perhaps this is why the explanatory power of the logistic regression models was low.

A positive finding regarding measurement in the study was the importance of separating the number of errors made during the first and final weeks of the program, as the error rate was not constant. There would be a potential for bias in future research if a single aggregate error rate was used. Future research should focus on using more valid and reliable measures of the power components and use prospective designs in order to increase the explanatory power of the models.

The Theory of Self-Care Deficit was used to select the variables to be included in the overall model, but the theory could not be fully operationalized as the data were collected retrospectively and not all variables were available. The relatively small proportion of the variance in the probability of making one or more errors accounted for by each model may be in part due to a lack of data on variables that may have been important. Other variables that may have been important to predicting success or failure in the self-medication program and the probability of making one or more errors include socioeconomic status, perceived health status, self-efficacy, learned helplessness and direct measures of self-care agency, motivation or apathy. Future research into this area should try to capture other variables not assessed in this study, but still relevant to the Theory of Self-Care Deficit.

Logistic regression analysis did not permit the specification of complex relationships between predictor variables, which may be important to the theoretical framework. Consequently, direct and indirect effects of variables could not be elucidated, as they could not be modeled correctly. An example of where this became problematic was the inability to separate the contribution of cognitive and physical function components of the IADL's. It could not be concluded that the movement abilities factor

of the power components was supported by the model, because the IADL's could have been important in predicting the probability of making errors due to their cognitive component. Path analysis or LISREL, using a more complete model would be a better approach to clarify relationships between predictors. Logistic regression analysis did allow interaction effects to be modeled and several of these interactions proved to be statistically significant; therefore, it is important that future research include evaluation of these and other interactions when exploring the relationships between predictor variables.

The final research implication comes from the theoretical framework itself. While medication management is an example of self-care and a deliberate action, the Theory of Self-Care Deficit may not be adequate in explaining this behaviour. In addition to requiring physical and cognitive abilities and motivation, medication management requires that individuals perceive a need to take their medications in accordance with the instructions received from health care providers and make the choice to adhere. Thus, managing medications without "error" extends beyond skills and abilities, as it involves certain health beliefs and values that are not captured by the Theory of Self-Care Deficit. There are also certain components of the Theory of Self-Care Deficit that may be extraneous. For example, a number of studies in the past have failed to support age, sex and education as basic conditioning factors, so it is not surprising these variables provided no explanatory power in the model here. While the Theory of Self-Care Deficit would seem to be a logical choice to guide research into medication management as a self-care behaviour, it may not reflect all issues in medication management. Future research into this area should consider theories that encompasses variables from the

Theory of Self-Care Deficit and variables known to influence compliance and decision making in self-care.

5.3.0 Practice Implications

The findings of this research study can be applied to practice in the community and institutional self-medication programs, as it may be of value in preventing medication errors in both environments.

The first implication for practice concerns the difference in the number of errors made during the first and final weeks of self-medication. This study confirmed that older adults are more likely to make errors when self-administering medications during the first week, indicating that with sufficient teaching and adequate support, the number of errors made can potentially decrease with time. If the relatively few number of errors made can be attributed to the program, this study shows that making a single error should not necessarily preclude self-administration of medications, as medication management skills can be learned and medication management may improve as a result.

The second practice implication is that it is easier to identify older adults who will continue to make medication errors after one week of self-administering medications than individuals who will make one or more errors in the initial week. Using separate analyses for the first and final week on self-medication allowed for these unique comparisons to be made, each providing distinct insights for practice. Distinguishing individuals with a high probability of making one or more errors during the first week of self-administration would allow healthcare providers or other caregivers to identify older adults that may have a larger self-care deficit. These older adults may need more frequent monitoring or additional support in order to meet their therapeutic self-care demands. This approach

would have a number of benefits. It would allow providers to be proactive in preventing unintentional errors, would allow for targeting of resources and would prevent unnecessary intervention that could impinge upon older adults' autonomy, reducing their self-esteem and promoting dependent behaviours.

Predicting which individuals are likely to continue making errors after self-administering medications for more than a week is also highly relevant. Knowing which older adults have a higher probability of making errors after two weeks of supervised self-administration allows providers and caregivers to identify individuals whose self-care deficit is not easily corrected by the educative/supportive or partially compensatory system. These individuals would require close monitoring and would have a higher probability of requiring intervention.

Only 8.6% of the study sample had the self-medication program terminated and only 26% of individuals on the self-medication program for two weeks continued to make errors into the final week. It is possible that the use of compliance packaging (i.e. weekly Dosetts) may have been sufficient to compensate for any self-care deficits that individuals may have had. Another factor that could have contributed to the participants' success in the self-medication program could have been the teaching that participants received from the pharmacist and the reinforcement received from nursing staff. Thus, a combination of education, reinforcement and compliance packaging could have lead to the participants' success.

Provided that the selection of older adults for participation in the self-medication program did not favour those with a high probability of success, the high success rate on the self-medication program may support the assertion that medication teaching

combined with compliance packaging, such as a Dosett, can substantially reduce the number of medication errors that older adults make. Thus, it is important to screen for older adults likely to make medication errors and identify and compensate for any self-care deficits with the appropriate level of intervention, since an intervention is likely to be of some benefit. It is well within the scope of community pharmacy practice to provide such interventions, and the results of this study support the notion that these programs are of value in reducing medication errors. As well, such programs are of value because they allow older adults to continue to engage in self-care, which has been shown to promote well-being and preserve autonomy and independence.

Perhaps the most important practice implication relates to the variables that were statistically significant predictors of the probability of making one or more errors. In the multivariate analysis, some of the items that were statistically significant included cognition, medication regimen complexity and ability to perform several IADL's. While medication regimen complexity is available from community pharmacy profiles, the measures of cognition and ability to perform IADL's are not. There are two ways in which this issue could be overcome to permit pharmacists to screen older adults with these criteria. One way would be to expand the role of pharmacists to include performing basic physical assessments or to incorporate a nurse into a community pharmacy practice setting. The other alternative would be for pharmacists to collaborate with other providers such as physicians or homecare nurses to access this information from their files.

The final practice implication again relates to the variables found to be statistically significant predictors of the probability of making one or more medication errors. Complex medication regimens often are the impetus for removing the

responsibility of medication management from the control of older adults. This study demonstrated that medication regimen complexity was not important when older adults' cognition was unimpaired and compliance packaging, such as Dosetts, were used. Thus, it is important to consider how cognitive function interacts with medication regimen complexity before removing the responsibility of medication management from older adults' control. Older adults cannot be considered a single homogeneous group that cannot manage their own medications once a certain degree of complexity is reached. The lack of significance of age as a predictor of the probability of making errors was also worth noting, since biological age may be thought to impede ability to manage medications, without considering cognitive and functional abilities.

In order to apply these results to practice, the internal and external validity of the study must be addressed. The major threats to internal validity in a causal-comparative or correlational design include chance, bias and confounding. Another possible threat to internal validity in this study was maturation effects, or instability of the measures, due to the lag time between measurement of particular variables and initiation of the self-medication program.

It is unlikely that chance had a significant role in the outcomes in the bivariate analyses, as this effect was controlled for using a correction to the level of significance. Possible sources of bias and confounding were observed in this study. The first was the possibility of observation bias, relating to the manner in which errors were tracked. It is conceivable that different nurses may have defined errors differently and may not have considered some errors extreme or severe enough to warrant documentation on the self-medication monitoring record. However, the probability that this misclassification of

errors would be differential is low, so it would be unlikely that the study results would be significantly impacted. It should be noted that this potential for observation bias was not due to the design of this study, rather it would have been a product of the self-medication program that occurred before this study was initiated.

There was also the potential for selection bias in the retrospective cohort portion of the study. Selection bias can occur when the manner in which patients are selected for inclusion in a research study is related to the outcome. Since only 8.6% of participants failed on the self-medication program, it is conceivable that patients who were likely to be successful were chosen for participation and individuals not likely to succeed were excluded. It may be difficult to conclude that certain variables predicted success or failure on the self-medication program when apparently 91.4% of the subjects had characteristics present that would predict success and the data on subjects likely to fail were limited.

A source of confounding in this study could have arisen from the lack of standardized frequency with which patients' progress was monitored while on the self-medication program. It is possible that the likelihood of having errors documented on the self-medication monitoring flow sheet would be higher for individuals who were monitored more frequently. If this assertion was correct and if the frequency of monitoring was determined in part by any of the independent variables, for example cognitive ability, complexity of medication regimen or functional status, the outcome could be confounded.

In regression analysis the potential of confounding or spurious common causes in explaining the observed relationships cannot be ruled out, particularly when a model cannot be completely specified. Thus, the model coefficients represent the effect of the

independent variables entered (controlled for by the other variables in the equation) as well as the effect of any variable with which the independent variables may be correlated, but not entered into the equation. In this study, certain variables such as education, socioeconomic status and self-efficacy could not be specified. Thus, the explanatory power of the variables included in the logistic regression analysis could be attributed in part to relationships with these or other variables.

The final item considered when assessing the validity of this study was maturation effects, or changes in the independent variables over time that were not accounted for. As previously discussed, this effect may not be problematic as some of the measures have been shown to be stable over time and predictive of outcome in a rehabilitation program.

To address external validity or generalizability of the findings, factors affecting population and ecological validity must be examined. To establish population validity, the study sample should be representative of the population to which the results were intended to be generalized. From the comparisons drawn to the community dwelling population of older adults in Canada, it is evident that the study sample had a higher proportion of females, was older, was more likely to have at least some high school education, had higher levels of cognitive and functional impairment and consumed more medications than the typical Canadian population. This is not surprising as the study sample was institutionalized.

These differences are not necessarily problematic as one would anticipate that the study sample may indeed reflect the population most frequently in contact with pharmacists and other healthcare providers in the community. If the goal of the study was to help pharmacists and other healthcare providers identify the population at risk for

difficulties with medication management, it would make sense that the study sample should differ in several of these characteristics. Thus, the goal would not be to generalize the findings to the entire Canadian population of older adults, but to older adults likely to use pharmacy services. In a recent study based in Alberta community pharmacies, the average age of participants was 73 ρ 6 years, 67% were female and almost 50% had some high school education (Kassam et. al., 2000). As well, the average number of medical conditions was 10 ρ 4.8 and the average number of prescription medications consumed was 8.7 ρ 5. Thus, the sample of older adults in this study seemed to reflect the clientele typical of a community pharmacy.

Ecological validity examines the degree to which the results from the study can be generalized to a different set of environmental conditions (Gall, Borg, & Gall, 1996). It was the intent that the findings of this study could be applied to a community pharmacy setting. While there are several differences between the rehabilitation hospital and the community, the ecological validity of this study was not entirely compromised. One important factor to consider is the Hawthorne Effect. The Hawthorne Effect can occur when individuals improve their performance because they are being observed or receiving special attention (Gall, Borg, & Gall). While this study did not evaluate the effect of an intervention, self-medication participants were aware that their performance was subject to evaluation. It is possible that they could have made more effort to avoid errors than they would in a community setting, devoid of such evaluation.

The impetus to make fewer errors in the rehabilitation hospital could arise from a unique system of rewards operating in that environment. Individuals in rehabilitation hospitals have less independence than they would in the community. Participation in self-

care is a mechanism by which individuals can maintain some independence and perceived control while in hospital. Thus, participation in the self-medication program has additional value, and participants may be motivated to protect this source of independence by striving to make fewer errors. Participants' self-care agency may actually be enhanced due to increased presence of the motivation factor of the power components. In the community, the threat of losing control over medication management is not as immediate, since individuals may be subjected to less scrutiny. As well, there are other sources from which individuals can derive a sense of control and independence, so the incentive to make fewer errors may be lower.

Another important difference which may affect the generalizability of these findings to the community is the additional support and cues that the study subjects received as part of the self-medication program. A self-medication program is an educative/supportive or partially compensatory system, depending on the magnitude of the participants' self-care deficits. Participants received their medications in Dosetts® and received instruction on their medications from the pharmacist. As well, the environment in the rehabilitation hospital was more structured than the community and provided more cues that participants could use as reminders to take their medications. The extent to which these factors are present in the community varies.

In the community, it certainly is possible to receive medications in a Dosett® filled by a pharmacy or family, and the same degree of instruction can be provided by community pharmacists or homecare staff. Indeed, there was an attempt by the pharmacist at the Glenrose Rehabilitation Hospital to ensure that a community pharmacy would supply the patient's medications in a weekly Dosett® following discharge.

However, in the community, the lack of structure, cues and reminders is not easy to rectify. The environment in the rehabilitation hospital is generally perceived to be more supportive than the community; thus, it is likely that individuals who still make errors in such an environment would be expected to be at a higher risk in the community. This point may be particularly important when considering individuals still making errors during the final week on the self-medication program, as they were discharged into the community with a potential self-care deficit.

While attempts can be made to generalize the findings of the study to the community setting, the predictive validity of all components of the model in differentiating between individuals who do and do not make errors has not clearly been established. The degree to which these findings can be generalized to the community depends upon similarities between the institutional setting and the community, and these similarities may be present to differing degrees.

5.4.0 Conclusions

Despite the limitations of this study, several important conclusions can be drawn from these data. First, medication regimen complexity, as measured by the MCI, may be less important in predicting medication management ability when cognition is unimpaired. That is, medication regimen complexity alone does not identify individuals at risk for making medication errors when compliance packaging, such as a Dosett® is used. Thus, pharmacists, other healthcare providers and caregivers should not make the assumption that older adults cannot manage complex medication regimens, without considering cognitive ability as well. Related to this, as would be anticipated, highly complex medication regimens are more problematic for and pose a greater threat to

individuals who have moderate to severe cognitive impairment. While cognition alone was a statistically significant predictor in several of the bivariate analyses, the logistic regression analysis revealed that its association with error rates could be attributed to its interaction with other variables.

Next, as the effects of institutionalization and depression were not consistent between the first and final weeks of self-medication, it is difficult to judge the importance of these findings, though statistical significance was achieved for each variable in one analysis. No strong conclusions can be drawn regarding the impact of either of these variables, but further assessment is warranted. A significant interaction was found between two IADL's and cognition. While money management would seem a good surrogate measure of ability to manage medications, it was significant only in the model for the overall week. As the dependent variable of the overall rate was somewhat of an aggregate of two dynamic rates, it may not be prudent to draw conclusions from these data. Again, money management and its interaction with cognition as predictors of errors in medication management should be researched further. The interaction between MMSE and cooking was subject to so many fluctuations that it could not be interpreted with any degree of certainty.

Finally, it can be concluded that the majority of older adults can manage their medications, particularly if compliance packaging is used. After two weeks on the self-medication program only 31 individuals (or 26% of individuals on self-medication for at least 14 days) continued to make errors. As well, the failure rate on self-medication was extremely low. These findings also show that compliance packaging and medication teaching or instruction enabled older adults to maintain their ability to manage

medications, even for the oldest of old (those greater than 85 years in age). Another important conclusion that can be drawn from these findings is that medication management can be learned through practice and familiarity, as the proportion of individuals making errors dropped between the first and final weeks. Thus, there is a great opportunity for pharmacists to identify older adults likely to have difficulties with medication management and to assist older adults to self-administer their medications, not only to reduce the number of errors made, but also to help them maintain control and independence in self-care.

Bibliography

Allen, S.M., & Mor, V. (1997). The prevalence and consequences of unmet need: Contrasts between older and younger adults with disability. Medical Care, 35 (11), 1132-1148,

Ascione, F.J. (1994). Medication compliance in the elderly. Generations, 18 (2), 28-34.

Ascione, F.J., & Shimp, L.A. (1984). The effectiveness of four education strategies in the elderly. Drug Intelligence and Clinical Pharmacy, 18, 926-931.

Barder, L., Slimmer, L., & LeSage. (1994). Depression and issues of control among elderly people in health care settings. Journal of Advanced Nursing, 20, 597-604.

Barry, K. (1993). Patient self-medication: An innovative approach to medication teaching. Journal of Nursing Care Quality, 8 (1), 75-82.

Botelho, R.J., & Dudrak, R. (1992). Home assessment of adherence to long-term medication in the elderly. Journal of Family Practice, 25 (1), 61-65.

Campbell, V.A., Crews, J.E., Moriarty, D.G., Zack, M.M., & Blackman, D.K. (1999). Surveillance for sensory impairment, activity limitation, and health-related quality of life among older adults: United States, 1993 -1997. Morbidity and Mortality Weekly Report, 48 (SS8), 131-156.

Canadian Institute of Health Information (1999). National Health Expenditure Trends (1975-1999) Report. [Online]. Available at: http://www.cihi.ca/medrls/execnhex.htm.

Canadian Medical Association. (1993). CMA policy summary: Medication use and the elderly. Canadian Medical Association Journal, 149, 1152A-1152B.

Canadian Study of Health and Aging Working Group. (1994). Canadian study of health and aging: study methods and prevalence of dementia. Canadian Medical Association Journal, 150, 899-913.

Carter, P.A. (1998). Self-Care Agency: The concept and how it is measured. Journal of Nursing Measurement, 6 (2), 195-207.

Cartwright, A. (1990). Medication taking by people aged 65 and more. British Medication Bulletin, 46, 63-76.

Claydon, B.E. & Efron, N. (1994). Non-compliance in general health care. Ophthamology, Physiology, and Optometry, 14, 257-264.

Coambs, R.B. et al. (1995). Review of the scientific literature on the prevalence, consequences, and health costs of noncompliance and inappropriate use of prescription

medication in Canada. Toronto, Canada: The Pharmaceutical Manufacturers Association of Canada.

Col, N., Fanale, J.E., & Krohhom, P. (1990). The role of medication noncompliance and adverse drug reactions in hospitalizations in the elderly. Archives of Internal Medicine, 150, 841-845.

Collingsworth, S., Gould, D., & Wainwright, S.P. (1993). Patient self-administration of medication: A review of the literature. International Journal of Nursing Studies, 34 (4), 256-269.

Conn V.S. Taylor SG. Wienke JA. (1995). Managing medications: older adults and caregivers. Journal of Nursing Science 1(1/2), 40-50.

Conn, V.S., Taylor, S.G. & Kelley, S. (1991). Medication regimen complexity and adherence among older adults. Image - the Journal of Nursing Scholarship 23 (4), 231-5.

Coons, S.J. et al. (1994). Predictors of medication noncompliance in a sample of older adults. Clinical Therapeutics, 16 (1), 110-117.

Day, R.A., Moore, K.N., & Hodgins, M. (1996). The effects of instruction and practice on medication knowledge and compliance. Canadian Journal of Rehabilitation, 12 (1), 15-24.

Dodd, M.J., & Dibble, S.L. (1993) Predictors of self-care: A test of Orem's model. Oncology Nursing Forum, 20 (6), 895-901.

Doherty, W.J., Schrott, H.G., Metcalf, L, & Iasiello-Vailas, L. (1983). Effect of spouse support and health beliefs on medication adherence. The Journal of Family Practice, 17 (5), 837-841.

Eben J.D., Gashti, N.N., Hayes, S.E., Marriner-Tomey, A., Nation, M.J., & Nordmeyer, S.B. (1994). Self-care deficit theory of nursing. In Marrier-Tomey, A (Ed.), Nursing Theorists and Their Work (pp.181-198). St.Louis, MO: Mosby.

Edelberg, Shallenberger & Wei. (1999). Medication management capacity in highly functioning community dwelling older adults: Detection of early deficits. Journal of the American Geriatric Society, 47, 592-596.

Edwards, M., & Pathy, M.S.J. (1984). Drug counseling in the elderly and predicting compliance. Practioner, 228, 291-300.

Fineman, B, & DeFelice, C. (1992). A study of medication compliance. Home Healthcare Nurse. 10 (5), 26-9.

Fitten, L.J., Coleman, L., Siembieda, D., Yu, M., & Ganzell, S. (1995). Assessment of capacity to comply with medication regimens in older patients. Journal of the American Geriatric Society, 43, 361-367.

Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. Journal of Psychiatric Research, 12, 189-198.

Forsell, Y., Jorm, A.J., & Winblad, B. (1994). Association of age, sex, cognitive dysfunction, and disability with major depressive symptoms in an elderly sample. The American Journal of Psychiatry, 151 (11), 1600-1604.

Furlong, S. (1196). Do programmes of medicine self-administration enhance patient knowledge, compliance and satisfaction? Journal of Advanced Nursing, 23, 1254-1262.

Fulmer, T., & Gurland, B. (1997). Evaluating the caregiver's intervention into the elder's task performance: Capacity versus actual behavior. International Journal of Geriatric Psychiatry, 12, 920-925.

Gall M, Borg W, Gall J. (1996). Educational research: An introduction. White Plains, NY: Longman Publishers.

Gast, H.L., Deynes, J.C., Campbell, J.C., Hartweg, D.L., Schott-Baer, D., & Isenberg, M. (1989). Self-care agency: Conceptualizations and operations. Advances in Nursing Science, 12 (1), 26-38.

Glass, G.V., & Hopkins, K.D. (1996). Statistical methods in education and psychology (3rd ed). Boston, MA: Allyn & Bacon.

Greene, J.Y., Weinberger, M., Jerin, M.J., & Mamlin, J.J. (1982). Compliance with medication regimens among chronically ill, inner city patients. Journal of Community Health, 7 (3), 183-193.

Grymonpre, R.E. (1998). How pharmacists can optimize medication use by elderly patients. Pharmacy Practice, 14 (5), 67-72.

Grymonpre, R.E., Mitenko, P.A., Sitar, D.S., Aoki, F.Y., & Montgomery, P.R. (1988). Drug assoicated hospital admissions in older medical patients. Journal of the American Geriatric Society, 36, 1092-1098.

Gurland, B.J. Cross, P., Chen, J., Wilder, D.E., Pine, Z.M., Lantigua, R.A. & Fulmer, T. (1994). A new performance test of adaptive cognitive function: The medication management test. International Journal of Geriatric Psychiatry, 9, 875-885.

Havens, B., & Finlayson, M. (1999). Analyses of Canada's oldest of old: From the survey of ageing and independence. [Online]. Available at: http://www.hc-sc.gc.ca/seniors-aines/pubs/havens/table_e.htm

Hallworth, R.B. & Goldberg, L.A. (1984). Geriatric patients' understanding of labelling of medicines. British Journal of Pharmacy Practice, 6, 6-14.

Hammarlund, E.R., Ostrum, J.R., & Kethley, A.J. (1985). The effects of drug counseling and other education strategies on drug utilization of the elderly. Medical Care, 23, 165-170.

Hawe, P., & Higgins, G. (1990). Can medication education improve the drug compliance of the elderly? Evaluation of a hospital program. Patient Education and Counseling, 16, 151-160.

Hennekens, C.H. & Buring, J.E (1987). Epidemiology in Medicine. Boston, MA: Little, Brown and Company.

Isaac, L.M. & Tamblyn, R.M. (1993). Compliance and cognitive function: A methodological approach to measuring unintentional errors in medication compliance in the elderly. The Gerontologist, 33 (6), 772-781.

Jirovec, M.M., & Kasno, J. (1993). Predictors of self-care ability among the institutionalized elderly. Western Journal of Nursing, 15 (3), 314-326.

Jirovec, M.M., & Kasno, J. (1990). Self-care agency as a function of patient-environmental factors among nursing home residents. Research in Nursing and Health, 13, 303-309.

Jirovec, M.M., & Maxwell, B.A. (1993). Nursing home residents: Functional ability and perceptions of choice. Journal of Gerontological Nursing, 19 (9), 10-14.

Johnston, M., Clarke, A., Mundy, K., Cromarty, E., & Ridout, K. (1985). Facilitating comprehension of discharge medication in elderly patients. Age and Ageing, 15, 304-306.

Kassam, R, & Farris, K.B.

Kendrick R. & Bayne J.R. (1982). Compliance with prescribed medication by elderly patients. Canadian Medical Association Journal, 127 (10), 961-962.

Larrat, E.P., Taubman, A.H., & Willey, C.W. (1990). Compliance-related problems in the ambulatory population. American Pharmacy, NS30 (2), 82-87.

Lexchin, J. (1990). Prescribing by Canadian general practitioners: Review of the English language literature. Canadian Family Physician, 36, 465-470.

Lui, L, & Lazaruk, L. (1998). Validity of the Alberta Assessment and Placement Instrument (APPI) for use in admitting long-term care clients to homecare. Canadian Journal on Aging, 17 (3), 296-310.

Marin, R.S., Firinciogullari, S., & Biedrzycki. R.C. (1993). The sources of convergence between measures of apathy and depression. Journal of Affective Disorders, 28, 7-14.

Martin, D.C, & Mead, K. (1982). Reducing medication errors in a geriatric population. Journal of the American Geriatrics Society, 30, 258-260.

Maxwell, S. (1980). Pairwise comparisons in repeated measures designs. Journal of Educational Statistics, 5, 269-287.

McDermott, M.N. (1993). Learned helplessness as an interacting variable with self-care agency: Testing a theoretical model. Nursing Science Quarterly, 6 (1), 28-38.

McDowell, I. & Newell, C. (1996). Physical Disability and Handicap. In Measuring health: A guide to rating scales and questionnaires (2nd ed.). New York: Oxford University Press, Inc.

McGourty, L.K. (1988). Kohlman Evaluation of Living Skills. In Hemphill, B.J. (Ed.), Mental health assessment in occupational therapy (pp. 133-146). Thorofare, NJ: Slack Inc.

Menard, S. (1995). Applied Logistic Regression Analysis. Thousand Oaks, CA: Sage Publications.

Meyer, M.E. & Schuna, A.A. (1989). Assessment of geriatric patient's functional ability to take medication. Drug Intelligence and Clinical Pharmacy, 23, 171-174.

Millar, W. J. (1998). Multiple medication use among seniors. Health Reports, 9 (4), 11-7.

Morrow, D, Leirer, V., & Sheikh, J. (1988). Adherence and medication instructions: Review and recommendations. Journal of the American Geriatric Society, 36, 1147-1160.

Murray, M.D., Darnell, J., Weinburger, M., & Martz, B.L. (1986). Factors contributing to medication noncompliance in elderly public housing tenants. Drug Intelligence and Clinical Pharmacy, 20, 146-152.

National Council on Patient Information and Education. (1995). Prescription medicine compliance: A review of the baseline knowledge- a report of the National Council on Patient Information and Education. Journal of Pharmacoepidemiology, 3 (2), 3-36.

Nikolaus, T., Kruse, W., Bach, M., Specht-Leible, N., Oster, P., & Schliert, G. (1996). Elderly patient's problems with medications: an in-hospital and follow-up study. European Journal of Clinical Pharmacology, 49, 255-259.

Orem, D. (1991). Nursing: Concepts of practice (4th ed.). New York: McGraw Hill.

Orem, D. (1995). Nursing: Concepts of practice (5th ed.). New York: McGraw Hill.

Palmer,H.M., & Dobson, K.S. (1994). Self-medication and memory in an elderly Canadian sample. The Gerontologist, 34 (5), 658-664.

Patrick, L. & Howell, K. (1998). Mental status and self-medication ability in the elderly. Canadian Journal on Aging, 17 (4), 425-439.

Pedhazur, E.J. (1997). Multiple Regression in Behavioral Research (3rd ed.). Fort Worth, TX: Harcourt Brace College Publishers.

Resnick, B., & Daly, M.P. (1998). Predictors of functional ability in geriatric rehabilitation patients. Rehabilitation Nursing, 23 (1), 21-29.

Resnick, B., Zimmerman, S.I., Magaziner, J., & Aldelman, A. (1998). Use of the Apathy Evaluation Scale as a measure of motivation in elderly people. Rehabilitation Nursing, 23 (3), 141-147.

Ruscin, J.M. & Selma, T.P. (1996). Assessment of medication management skills in older outpatients. Annals of Pharmacotherapy, 30, 1083-1088.

Ryan, A.A. (1999). Medication compliance and older people: A review of the literature. International Journal of Nursing Studies, 36, 153-162.

Smits, M.W., & Lee, C.C. (1992). Correlates of self-care among the independent elderly: Self-concept affects well-being. Journal of Gerontological Nursing, 18 (9), 13-18.

Spagnoli et al. (1989). Drug compliance and unreported drugs in the elderly. Journal of the American Geriatric Society, 37, 619-24.

Spitzer, A., Bar-Tal, Y., & Ziv, L. (1996). The moderating effect of age on self-care. Western Journal of Nursing Research, 18 (2), 136-148.

Stewart, S., & Pearson, S. (1999). Uncovering a multitude of sins: Medication management in the home post acute hospitalisation among the chronically ill. Australia and New Zealand Journal of Medicine, 29, 220-227.

Sullivan, S.D., Kreling, D.H., & Hazlet, T.K. (1994). Noncompliance with medication regimens and subsequent hospitalizations: A literature analysis and cost of hospitalization estimate. Journal of Research in Pharmaceutical Economics, 2, 19-33.

Tombaugh, T.N., & McIntyre, N.J. (1992). The Mini-Mental State Examination: A comprehensive review. Journal of the American Geriatrics Society, 40, 922-935.

Torrible, S.J. & Hogan, D.B. (1997). Medication use and rural seniors: Who knows what they are really taking? Canadian Family Physician, 43, 893-898.

Vuckovic N. & Nichter, M. (1997). Changing patterns of pharmaceutical practice in the United States. Social Science and Medicine, 44 (9), 1285-1302.

Appendix A: Ethics Approval

Health Research Ethics Board

biomedical research

health research

UNIVERSITY OF ALBERTA HEALTH SCIENCES FACULTIES,
CAPITAL HEALTH AUTHORITY, AND CARITAS HEALTH GROUP

HEALTH RESEARCH ETHICS APPROVAL

Date:	March 2000
Name(s) of Principal Investigator(s):	Ms. Sheri Maddigan
Organization(s):	University of Alberta
Department:	Graduate Studies; Faculty of Pharmacy & Pharmaceutical Sciences
Project Title:	Identifying Predictors of Success, Failure and Error Rates in a Geriatric Self-medication Program: A Retrospective Chart Review

The Health Research Ethics Board has reviewed the protocol for this project and found it to be acceptable within the limitations of human experimentation. The HREB has also reviewed and approved the patient information material and consent form.

The approval for the study as presented is valid for one year. It may be extended following completion of the yearly report form. Any proposed changes to the study must be submitted to the Health Research Ethics Board for approval.

Sharon Warren

Dr. Sharon Warren
Chair of the Health Research Ethics Board (B: Health Research)

File number: B-240300-PPS

University of Alberta · Capital Health · CARITAS HEALTH GROUP

Capital Health

Regional Research Administration
Clinical Trials Centre
1800 College Plaza
8215 - 112 Street
Edmonton, AB T6G 2C8
Phone (780) 407-1372

NOTICE OF ADMINISTRATIVE APPROVAL FOR PROPOSED RESEARCH

Site: Glenrose

Project Title: Identifying Predictors of Success, Failure and Error Rates in a Geriatric Self-Medication Program: A Retrospective Chart Review

Project Number: M-227

Investigator Name: Maddigan, Sheri

Department: Faculty of Pharmacy and Pharmaceutical Sciences

Division:

Address: 3118 Dent/Pharm Building UofA

Phone: (780) 492-0092 **Fax:** (780) 492-3007

Supporting Documents

Ethics Approval Date: 15-Mar-00 **Ethics File #:** B-240300-PPS

Study Protocol Received

Source of Funds: Graduate Student - Part of thesis

Type of Funds:

Overhead rate: 0.00

Legacy Account: Uof A account **Oracle Account:**

Contract Finalized Date:

Revised:

Project Approved: 30-Mar-00 **Comment:** The Expenses Associated with this project will be paid from Sheri's supervisor's (Dr. Karen Farris) general research account.

THIS APPROVAL IS VALID FOR ONE YEAR

Kimberley Kordov
Regional Research Administration

K Kordov

Copies to: Department Chair/Health Sciences Faculty
Vicky Allcott, Director, Accounting Services
Phil Houchert, Manager Trust Research Accounts

Thursday, March 30, 2000

Capital Health

Healthier people in healthier communities

Community Care and Public Health

Glenrose Rehabilitation Hospital

Our File Number: *00-M-155*

Research Services

10230 - 111 Avenue
Edmonton, AB
Canada T5G 0B7

Tel: (780) 471-8212
Fax: (780) 471-7907

Ms. Sheri Maddigan
Faculty of Pharmacy and Pharmaceutical Sciences
3118 Dentistry/Pharmacy Center, U of A
Edmonton, AB T5K 0H2

March 24, 2000

Dear Ms. Maddigan:

Re: ***Identifying predictors of success, failure and error rates in a geriatric self-medication program: A retrospective chart review***

This letter is to inform you that your application to conduct research at the Glenrose Rehabilitation Hospital Site for the above mentioned project has been approved and registered. You have received approval to conduct research in the following service areas:

Patient Information Services
Pharmacy

If there are any changes to the programs/clinics from which subjects will be recruited, please notify us in writing as soon as possible. We also ask that you inform our office when you have completed your project so that your file can be closed.

If you have any questions, please contact Michael MacIsaac at 471-8212.

Thank you,

Sandy Litman, MEd, CPsych
Office of Research Services

Cc: Michael MacIsaac
Kimberley Kordov

Glenrose Rehabilitation Hospital Site

Appendix B: Data Abstraction Form and Patient Assessments

Data Abstraction Form

Chart Number: _____ Admission date to Glenrose:_____Reason for Admission:_____

Duration of Institutionalization Prior to Admission:_____

Age:_____ Sex: M F Marital Status:_____

Hearing Impairment: YES NO Visual Impairment: YES NO

Chronic Medical Conditions: Depression: YES NO

Total Number of Medical Conditions:

Date of program initiation:_____ Number of days on program:_____

Date of program termination:_____ Reason for termination of program:_____

Duration of time on self-medication:_____

Length of stay in rehabilitation hospital prior to initiation of self-medication program:_____

Functional Assessment:

MMSE Score:_____ KELS:_____

FIM Motor:_____ FIM Cognitive:_____

Activities of Daily Living

ITEM	FUNCTIONAL
Eating	
Grooming	
Bathing	
Dressing-Upper Body	
Dressing-Lower Body	
Toileting	

Instrumental Activities of Daily Living

ITEM	FUNCTIONAL
Cooking	
Shopping	
Money Management	
House Work	
Laundry	
Transportation	

Error Rates:

	INITIAL WEEK	FINAL WEEK	OVERALL
Number of errors			
Number of days	7	7	
Error rate			

Nursing Assessment Data:

ITEM	YES	NO				
Manage own medications						
Recent medication changes						
Any difficulties with medication management						
			VIALS	DOSETT	7-DAY PILL BOX	BLISTER PACK
Packaging used prior to admission						

Pharmacy Assessment Data:

ITEM	YES	NO			
Manages own medications					
			SMALL TYPE	NORMAL TYPE	UNABLE
Read label					
			YES	WITH DIFFICULTY	NO
Open vial					

Medications

NAME	INDICATION	STRENGTH	DOSAGE	DOSAGE FORM	LABEL DIRECTIONS	MCI SCORE
Total Number of Medications						Total MCI Score

Glengarry Rehabilitation Hospital

NAPRG PROGRAM

Pharmacy assesenant form (used by pharmacists if needed)

Pharmacy Assessment
Geriatric Services

A. PATIENT MEDICATION HISTORY (including over the counter medication)

MEDICATION	DOSE	FREQUENCY (When?)	PURPOSE	COMMENTS

Have you ever had a reaction to a medication?

No ☐ Yes ☐ (If yes, describe) _____

B. COMPLIANCE/ATTITUDES

1. Do you manage your medications on your own?

   Yes ☐ No ☐

   Who helps you? _____

2. Is there anything special you do that helps you to remember to take your medications?

   No ☐ Yes ☐ _____

3. What would you do if you missed a dose of your medicine?

   _____

4. What do you do about your medicine if you have to go out during the day? Assessment form

5. Where do you store your medications?

6. Do you keep your medications in their original containers?

7. When you stop taking a medication what do you do with the remaining supply?

8. Name of community pharmacy _____ Phone No _____
   Will they deliver? Yes ☐ No ☐
   How do you get your medications from the pharmacy?

9. Would you like to learn more about your medications?

C. ABILITIES

1. Vial Test: Yes ☐ With difficulty ☐ No ☐

2. Label Test: Normal Type ☐ Large Type ☐ Unable to Read Type ☐

3. Other: _____

PHARMACIST'S COMMENTS:

Date: _____ Signature: _____
B.Sc. Pharmacy

Sunnybrook Rehabilitation Hospital

Women's College Hospital Geriatric Program

Geriatric Nursing Assessment

Medication screen on each chart for nurse doing admission to complete (pharmacist can add to the info, but staffing is insufficient to have pharmacist see each pt. at admission)

1. **Allergies/reactions to medications (including anesthetics), foods or blood transfusions**
   Do you have any allergies? ☐ yes ☐ no ☐ not known Any reactions to medications? ☐ yes ☐ no

If yes, what are you allergic to?	List allergies	Describe your reaction (eg. rash, fever, hives)
Medications		
Food & other (eg. shellfish, latex, soap)		

2.

Medication/dose	Patient's Understanding	MD
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

3. **Over-the-counter medications** — For additional medications see reverse →

Sleeping	Vitamins
Constipation	Cough/cold
Pain/headache	Breathing
Eyes/ears	Indigestion
Herbal products	Other

4. **Any recent medication changes?** ☐ yes ☐ no ie. deletions or additions
   If yes: _____

5. **Medication administered by:** ☐ patient ☐ others _____
   System used ☐ bottles from Pharmacy ☐ dosett ☐ 7-day pill box ☐ blister packs ☐ other _____
   filled by ☐ patient ☐ family/caregiver _____ ☐ pharmacy ☐ homecare nurse

6. **Any difficulties with medication management?** ☐ yes ☐ no
   If yes: _____

7. **Community Pharmacy?** _____ Phone: _____
   Delivered: ☐ yes ☐ no Picked up by: ☐ patient ☐ other _____

C.R. 1328-08/97 Page 3 of 3

Date | Initials

Glenrose Rehabilitation Hospital

NAPRAG PROGRAM

Self Medication Monitoring Record

Self med monitoring record used by nursing staff. Pharmacist determines frequency of monitoring. If major problems they are to be documented in patient progress notes + pharmacist notified (or physician).

A. (PHARMACY to complete Section A)

Date: _____ Frequency/Times of Monitoring: _____

B. (NURSING to complete Section B)

DATE	TIME	INT.	COMMENTS